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ABSTRACT

This paper reviews observational studies of infant-environment interaction during the first year of life. First, the utility of ecological and ethological perspectives for the assessment of organism-environment interactions is explored. Second, the observational research is categorized and discussed along methodological lines in terms of variable choice (social, social and physical, or cultural) and with respect to type of analysis (sequential or non-sequential). The final section of the review provides conclusions concerning the relationship of environmental assessments to developmental progress and demographic variables. Parallels between the reviewed studies and ethological theory and methods are pointed out. Directions for future research are suggested. (Author/RH)

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ASSESSMENT OF INFANT ENVIRONMENTS: A REVIEW OF THE LITERATURE

by

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I. Introduction

A. Why Assess the Environment?

The lack of predictability from infant intelligence tests to later levels of cognitive functioning has lead some researchers to question the value of the unrewarding search for behavioral stability. Both Kagan (1971) and Scarr-Salapatek (1976) have proposed qualitative differences between sensorimotor intelligence in infancy and subsequent symbolic intelligence, accounting for discontinuous developmental patterns. Alternatively, the quest for continuity in IQ indices alone can be regarded as an over-simplification of a complex developmental process, by assuming that environmental influences on development are either constant over time or absent altogether. Perhaps predictability would be enhanced if assessment of infant environments and infant individual difference measures were used in combination (Richards, 1977; Sameroff & Chandler, 1975).

Historically, a number of scientists did suggest the importance of a child's earliest environment on learning and development. Both Tiedemann (1787/1975) and Darwin (1877) structured their "baby biographies" around their infant's reactions to the variety of visual, auditory and tactile stimuli surrounding them. The development of institutionalized children was studied extensively in the mid-1900's. Rene Spitz (1945) described a "hospitalism" syndrome of apathy, lethargy, and retardation among orphaned children. Skeels and Dye (1939) experimentally manipulated early institutional environments resulting in provocative, yet controversial, effects lasting into adulthood (Skeels, 1966). Although neither Spitz nor Skeels systematically recorded the specific environmental deprivations

implied in institutional environments, retardation was assumed to result from some combination of early experiential and genetic effects.

Although environmental effects were first denied by Dennis, a review of his work from 1939-1960 (Hunt, 1961) documents a shift toward an interactionist view. Early experiences below a certain threshold were shown to effect both mental and motor development (Dennis & Najarian, 1957). Indeed, Dennis and his colleagues were among the first to note that environmental deprivation could directly influence intelligence assessment. Institutionalized children who lacked the behavioral repertoire (e.g. sitting, social responsiveness to tester) to score well on intelligence tests were shown to improve their test scores with practice of these prerequisite skills (Dennis & Sayegh, 1965).

Perhaps the first important theoretical basis for early environmental effects came from Hebb's classic work on the foundations of intelligence (Hebb, 1949). According to Hebb, primary learning was through perceptual experience, and the basic units of cognitive functioning (cell assemblies) were images of that experience. Thus, IQ indices used without an understanding of the individual's early environment presented, at best, an incomplete picture. "We cannot in any rigorous sense measure a subject's innate endowment, for no two social backgrounds are identical and we do not know what the important environmental variables are in development of intellectual functions" (Hebb, 1949, p. 300).

Subsequently, another theorist revolutionized our views of a child's interactions with the environment. Piaget's notions of assimilation and accomodation of an infant's perceptual experiences helped to specify the importance of both environmental variety and constancy at different

"critical periods" in development (Piaget, 1973). As interpreted by Hunt (1961), "the more new things an infant has seen and the more new things he has heard, the more new things he is interested in seeing and hearing; the more variation in reality he has coped with, the greater is his capacity for coping" (p. 262). More recent interpretations of Piaget's theory (Hunt, 1976; Wachs, 1976) have further implied that a "match" between an infant's cognitive level and the experiences available produces optimal developmental progress.

Although the early studies of Spitz, Skeels and Dennis were important in suggesting early experience effects, their global references to some early environments as "deprived" precludes their service as models for present-day environmental research. Yarrow (1961) reviewed the maternal deprivation literature through 1960 and found only one study (Rheingold, 1960) that made an attempt to objectively describe an institutional setting. He went on to suggest that institutional environments differ generally in the quantity and quality of sensory stimulation they have available, as well as in specific variables such as consistency of personnel and predictability of caregiver response.

Researchers in the 1960's and early 1970's moved from a gross classification of early experience as "deprived" to another little-understood categorization of groups as to "socio-economic status," or SES (Tulkin, 1977). This use of SES as an independent variable has contributed to an unfortunate assumption of homogeneity within SES groups (Richards, 1977). If one assumes, for example, that all lower class homes provide a similar environmental pattern, then parceling variance along SES lines simplifies the problem of assessing environmental influence. Suprisingly,

the use of SES as an independent variable has been rewarded with moderate yet consistent correlations with psychological dependent measures (Horowitz, 1977). Clarke and Clarke (1977) argue that "the surprising effectiveness of SES lies in its role as a sort of multiple R, to which large numbers of individually less powerful variables contribute" (p. 50). This view of SES as an appropriate statistical summary variable has not been supported by investigations within a single social class. Significant within-group variability has been shown in home stimulation inventories (Elardo, Bradley, & Caldwell, 1975), interaction observations (Yarrow, Pedersen, & Rubenstein, 1977), and intelligence assessments (Lewis & Goldberg, 1969). Using SES as a grouping variable may be masking developmental continuities by ignoring variance within classes. Asking how class membership affects children may be a better tactic to understand the process of development, rather than stressing social class differences (Tulkin, 1977). Studying similarities between groups, such as value systems that override social class strata, may help define important process variables (Lewis & Ban, 1977).

The progression from global descriptors to the environmental specificity outlined above is a relatively new trend in child development research. Careful observers of the developmental process are just beginning to put their assumptions of environmental influence into practice by including environmental variance in the equations they derive to predict developmental outcome. As our techniques for assessing environmental inputs become more sophisticated, our search for predictability from infancy to later childhood, reflecting the larger goal of understanding how development happens, may yet be rewarded.

B. How to Assess the Environment?

1. A perspective

An infant's ability to produce isolated behaviors for a strange adult in a structured testing situation may not be the best indicator of developmental progress. Various processes may interfere with a valid assessment. The infant's typical level of responsiveness may be suppressed by the unfamiliar situation. The set of test items may not encompass a behavioral repertoire which the infant has found to be adaptive within familiar surroundings. Even if cognitive capabilities are accurately assessed in the testing situation, they may not be supported or maintained by the infant's environment, and therefore individual differences cannot be expected to be stable when assessed longitudinally. In any case, biased prediction of developmental outcome may result.

Repeated observations of the infant within a naturally-occurring context may prove to be a better strategy than structured intelligence assessments for understanding the developmental process. However, observational research is complicated by the enormous complexity of organism-environment interplay. Infant behaviors and environmental events may seem random and disorganized, eluding quantification and theoretical understanding (Barker, 1963). Willems (1973) has proposed that an ecological perspective may be useful in investigating such complex environmental systems.

An ecological perspective, most concretely demonstrated by the "Kansas tradition" of ecological psychologists, views an individual's stream of behavior and environmental milieu as irrevocably intertwined.

Allowing that behavior stream to "take its natural course" and not limiting or manipulating environmental events are goals of ecologists (Gump & Kounin, 1960). Potential rewards to be gained from this research perspective include mapping the distribution of behavioral phenomena in nature, observing behavioral accomplishments in everyday environments, and understanding processes which would be difficult or unethical to manipulate experimentally. This list is not exhaustive, as archives of ecological data allow many unanticipated research questions to be asked of the data at a later time (Barker, 1969).

Infant research in general has much to gain from an ecological perspective. Interventions into infant environments without detailed understanding of the complex environmental system may produce unanticipated, undesirable "side effects" which could prove to be more difficult than the original insult (Willems, 1973). Even knowledge of infant capabilities gained from laboratory experiments should be reproducible in the natural environment before generalization is assumed. As Gump and Kounin (1960) stated, "if one wishes to generalize from his experiments to natural milieus and behaviors, considerable ecological knowlege is necessary. Variables from the general milieu may intrude in the clearest experiment; behaviors responsive to experimentally induced forces may be even more responsive to different forces when the behavior stream can take its natural course" (pp. 148-149).

2. A theory

If an ecological perspective is adopted to determine the scope of developmental processes-in-context, a related discipline may provide complementary theoretical and methodological foundations. That discipline is ethology, traditionally devoted to animal behavior, but more recently applied to human concerns. While psychology has modeled itself after the physical sciences (which investigate small, relatively well-understood systems), ethologists, historically trained as zoologists, have modeled their theory more along the lines of biology, investigating large, complex systems (Jones, 1972). The implications of a biological perspective on infant behavior are profound. Biologists attempt to study behavior as they might study an organ system: in terms of its development, causal control, survival value, and evolutionary significance. The first two perspectives are well-known to developmental psychologists, while survival value and evolutionary adaptiveness may seem to be foreign concepts.

Freedman (1974) has attempted a synthesis of ethological theory with infant research. The recently differentiated behavioral repertoire of the human newborn was discussed as promoting infant survival. Visual tracking, auditory localization, reflex rooting, sucking, swallowing and grasping, as well as an appealing physical appearance, may all be viewed as being extremely adaptive for the helpless newborn in eliciting care from adults. A natural experiment to test this survival value hypothesis is possible when these neonatal characteristics are disrupted, such as in the case of a premature infant, where there may be an increased risk of a breakdown in the caregiving system in the form of physical abuse or neglect (Klein &

Stern, 1971). While physical abuse obviously relates to survival, as Omark (1977) stated, "for a social species, 'survival' is not important just in a physical sense, but also in a social and psychological sense" (p. 44). Thus, infant-environment transactions that result in variant psychological outcomes may also be said to influence survival.

An evolutionary perspective may be more difficult for developmental psychologists to adopt since variables must be investigated at the population level. Freedman (1974) suggested a heirarchy of hereditary and environmental influences to understand evolutionary contributions to development. (It should be noted here that ethologists do not dichotomize genetic and environmental factors, for as Tinbergen (1972) has stated, 'many interactions with the environment which result in increased efficiency are additive to some machinery that was already functional" (p. 230). In other words, every behavior has both an innate and an acquired component.) At the top of the heredity-environment heirarchy are infant capabilities such as perceptual constancy and primary mental abilities which have been genetically selected from relatively invariant environmental pressures, and so are not as subject to environmental changes. Adding environmental measures to infant assessments at this end of the heirarchy would probably not be as profitable as for social behavior, which Freedman (1974) hypothesized to be genetically preprogrammed to be malleable, since our socio-cultural context changes so rapidly. Observations of infant-environment relationships may be served by such an evolutionary perspective, for it suggests a theoretical basis for behavioral constancies and variance in the face of contextual influences.

3. A methodology

In terms of specifying a methodology to understand behavior in its larger context, animal ethologists and infancy researchers share a common problem: neither the organism nor the environment relies on symbolic functions to communicate. Non-verbal behavior is the data base upon which both fields must rely. Some developmentalists have already adopted ethological methods to understand infant social and discriminatory functions. The use of film or videotape to preserve organism-environment interactions for later analysis is an ethological technique (Charlesworth, 1975), now being used to study mother-infant interactions (e.g., Rosenfeld, 1973). Robert Fantz, protege of an ethologist, developed a widely-used technique to allow infants to communicate visual pattern preferences non-verbally (Freedman, 1974). However, the most well-known methodology used in ethological research involves field observations of the organism in the natural habitat, in which environmental and behavioral events are carefully described.

The finer points of adapting ethological methodology to infant-environment research can be difficult. Category selection, coding intervals, code design, observer influence and observer reliability are all problems which researchers interested in natural observations must address.

In terms of category selection, Jones (1972) proposed the usefulness of an ethological viewpoint. Animal ethologists consider a "natural history phase" to be an essential first step to any study. This involves an initial period of hypothesis- and category-free observations, in which behavioral and environmental events are described in a narrative fashion.

Jones (1972) suggested that both categories and hypotheses will be easily generated by such unrestrained recordings, and that the results may be more relevant to the target population.

The selection of coding intervals which depend upon the observer's technical limitations versus inherent, natural breaks in the behavior stream have profound implications on the interpretation of orgainism-environment interactions (Barker, 1963). While continuous recording can be exhausting and time consuming, the theoretical importance of subtle infant-environment contingencies may force more commonly used time-sampling techniques into disuse. In time-sampling, the behavior stream is broken into arbitrary intervals, and events are not coded as to their frequency or order of occurrence within an interval. Recent technological advances have made electronic, continuous computer-compatible coding available (Sackett, Stephenson, & Ruppenthal, 1973), but paper-and-pencil techniques are still more prevalent. It will become increasingly apparent that arbitrary sampling constraints imposed on the stream of behavior in time-sampling strategies severely limit the interpretations that can be made from the data.

An additional problem noted by Yarrow is that "isolation of variables in the natural environment is an artificial one; in reality many variables are active simultaneously" (Yarrow et al., 1977, p. 561). Gewirtz and Gewirtz (1969) saw the solution as mutually exclusive and exhaustive coding schemes, which allow combinations of variables to be scored simultaneously, not sequentially. Without such a coding scheme, each variable must be analyzed independently, as if it occurred in isolation. Exclusive/exhaustive codes permit co-occurring behaviors to be coded

and thus analyzed as a unit, better reflecting the complex nature of interactive sequences.

Ethology's typical lack of concern for observer reliability data has been clearly expressed by Jones (1972): "intense concern for inter-observer reliability testing is fairly characteristic of social and developmental psychology and may have had its origins in the non-replicable nature of the measures that were being attempted (possibly related to the non-operational nature of the concepts being gauged by the measures)" (p.13). Contrary to this view, it seems that the more complex a system one is observing, the more breakdowns in observation quality are likely to occur. If data are to be shared across research settings, confidence in observational results may be based on assumptions of observer training to some criterion, reflected in reported reliability data. While most researchers are probably genuinely concerned about observer reliability, the lack of consensus about acceptable agreement levels and the lack of communication between statisticians and researchers about the best statistical techniques to use make interpretation of reported reliability data difficult (Hollenbeck, 1977). Ethological methodology, by stressing operationally defined categories which rely to a smaller degree on observer inference, may indirectly suggest one solution to reliability problems: objective coding schemes may reduce observer confusion in coding behavioral and environmental events (Charlesworth, 1975).

C. What is an Infant Environment?

It is generally the case that researchers choose to concentrate on those aspects of the infant's environment which their theoretical orientation implies are functional influences in the infant's development. Some concensus has emerged on focusing on the sensory environment in terms of visual, auditory, and tactile inputs (olfactory and gustatory qualities of the environment have not been extensively studied). A major discrepancy exists in choosing the sources of sensory stimulation to include in environmental assessments.

The most obvious source of visual, auditory, and tactile stimulation in an infant's world is the social environment, and the infant's mother has typically been the focus of studies attempting to assess environmental patterns of social stimulation. The infant's physical environment has only recently been acknowledged as a possible contributor to sensory stimulation, and only rarely have a combination of animate and inanimate sources of sensory stimulation available to the infant been recorded in environmental assessment research.

As noted above, "maternal deprivation" was the global beginning of environmental assessment. Yarrow (1961) and Casler (1961) suggested that what was called maternal deprivation was probably a decrease in the amount and kind of specific sensory stimulation available to institutionalized infants. According to Yarrow, in the first six months of life (or until an infant recognizes the existence of objects outside of himself, and begins to comprehend their permanence) it might be more accurate to say that institutionalized infants were deprived of those sensory experiences usually provided and mediated by a mother figure, rather than being deprived of "mother love." After six months, the consistency of the mother

figure or a small group of surrogates, and the predictability of her behavior were noted by Yarrow to be important in the infants' perception of object permanence, object constancy, and concepts of time (Yarrow, 1968). While Yarrow and his colleagues (1977) acknowledged the need to operationalize such intangibles as "warmth," his suggestions have allowed researchers to clarify the specifics of sensory stimulation encompassed by maternal care. However, a conceptualization of infant social environments in terms of maternal stimulation alone may provide an incomplete picture of the animate variables functional in development. While the contribution of the father to the infant's social environment has not been systematically investigated (Lamb, 1975), there is some evidence that qualitative differences exist in the type of interactions that fathers initiate (Lamb, 1977). Lamb (1977) goes as far as blaming researchers' emphases on mother-infant relationships for contributing to the "devaluation of the father's role" (p. 260).

Other sources of social stimulation in a young infant's world have been investigated rarely, but with interesting effects. White (1975) suggested that interactions with siblings may provide a positive or negative source of stimulation to an infant, depending on if the children are more than three years apart or are closely spaced. Wachs, Uzgiris, and Hunt (1971) included the number of visits by relatives to a young infant's home in his stimulation inventory, based on significant correlations of that variable with infant development. As environmental assessment research begins to broaden its focus on important sources of social stimulation in the first year, relationships between infant development and the environmental context may be clarified.

If assessment of the infant's social environment has been restricted, the physical environment has been generally ignored. Some investigators have recently begun to attend to the inanimate environment because data indicate that infants spend a fair amount of awake time interacting with environmental objects. For example, Clarke-Stewart (1973) found that nine- to 13-month-old infants spent an equal amount of time interacting with objects as with their mothers. White (1975) similarly estimated that year-old infants spend approximately 20% of their awake time actively exploring objects. Until recently, however, we have been without a theory to interpret specific effects of the physical environment (Tulkin, 1977).

Yarrow, Rubenstein, and Pedersen (1972) postulated that the inanimate environment may influence cognitive-motivational and exploratory development, while animate stimulation may relate to social responsiveness and language development. His data support such a theory with moderate yet consistent correlations. It appears that both animate and inanimate variables may be important in understanding how the environment interacts with the individual in the process of development.

Both Caldwell (Elardo, Bradley, & Caldwell, 1975) and Wachs (Wachs, Uzgiris, & Hunt, 1971) have provided inventories to assess the related to developmental theory. Wachs based his inventory on physical environment. Here a distinction may be made between assessing only those aspects of the environment with which the infant is observed to interact, and a more thorough description of both active and passive environmental properties. While both the Caldwell and Wachs inventories allow assessment of the active and passive environment, and thus are both important contributors to

environmental research, the Wachs inventory is more clearly related to developmental theory. Wachs based his inventory on Piaget's theory of the importance of an infant's interactions with objects in developing schema about the world (Wachs, 1976). His assessment includes measures of environmental predictability, the adequacy of stimulation offered to the child, and the presence of intense stimulation from which the infant is unable to retreat. In research assessing the differential response of groups of infants to environmental variables (such as sex differences), Wachs (1978) further suggested that "the physical inanimate environment may be less susceptible to child effects and therefore may offer a better ground for a test of the differential reactivity hypothesis" (p. 1).

The data and theoretical orientation supplied by Yarrow, together with recent inventories encompassing physical aspects of an infant's environment, no longer limit the environmental researcher to social sources of stimulation. Just as a wide range of infant individual difference parameters have been defined, the ecological context of infant behavior may now be assessed in its total configuration of animate and inanimate sensory experiences.

D. In What Contexts Should the Environment Be Assessed?

Even as infant behavior is better understood in the context of the social and physical environment, environmental patterns exist in a larger, cultural context. Whether one is observing an infant-environment interaction in one's own culture, in a different subculture, or in a foreign land, the cultural context of beliefs, values and goals for child development

mediate social and physical variables.

Progress in understanding the process of development is not likely if child care customs are interpreted only in the context of the observer's value system. Research which does not attempt an understanding of the broader cultural context of behavior is not truly cross-cultural, but rather should be labeled comparative psychology. Tulkin (1977) stressed that it is extremely important "to know what mothers and other caretakers think they are doing, what their goals are for their children, and what some of the overall values are for the society" (p.574). Such an in-depth perspective on another culture is difficult without repeated or long-term exposure to that culture (Goldberg, 1977).

Levine (1977) has provided an example of gross misinterpretation of a child care practice when viewed from a Westerner's perspective. Observers of African cultures have repeatedly labeled the practice of constant carrying of an infant in a sling, close to the mother's body, as "indulgence." If an American mother carried her infant constantly, such a label might be appropriate. However, in a cultural context where infant mortality is extremely high, carrying is appropriate for constant monitoring of illness. Survival is at issue here, not indulgence or the implied spoiling of a child.

Is there a strong rationale for maintaining a cross-cultural perspective in child development research? Kagan (1977) suggested that infant- environment relationships which appear to be linear within one culture may be better described by non-linear functions when levels of a variable not found in our country are observed cross-culturally. Hypotheses can be refuted, such as the generalizations of newborn

precocity, which did not hold up in at least one study (Konner, 1977), and which have not been replicated across behaviors other than in the motor area (Kagan, 1977). Leiderman, Tulkin, and Rosenfeld (1977) provided a further rationale for cross-cultural work, citing "the natural variation of child-rearing practices through the world" which make it possible "to find natural experiments in which events or social stimuli usually 'packaged' together in our society occur in isolation" (p. 9).

Even within our own culture, these perspectives are valuable in understanding how ecological factors and belief systems influence child care. For example, Lewis and Freedle (1977) caution against using the popular variable of "floor freedom" in lower class homes, where the floor may be cold and unsafe. Perhaps the general child care goal of reinforcing active exploration might be addressed in different ways in a poverty home. Some knowledge of the means by which ecological factors influence caretaking practices may aid our interpretations of sub-cultural differences.

An even more intangible influence on child care goals--the caregiver's belief system--must also be understood in a subcultural group. Both Lewis and Goldberg (1969) and Tulkin (1977) found that working class mothers in general felt they had less control over their infant's development. This "powerlessness" or "fatalism" influences levels of responsiveness and interaction in an understandable way. Other lower class mothers, when asked about their lack of responsiveness to their infants, have stated that the child's life was going to be hard, and "spoiling" at an early age was inconsistent with their goals of self-reliance and independence for the child.

Recording only the topography of a caregiver's actions vis-a-vis the infant may limit our understanding of how cultural values influence developmental outcome. An alternate goal might be to assess the effectiveness of cultural transmission of a society's belief system regarding optimal early child development. Such a perspective may prevent ethnocentric bias from shading our interpretations of cross-cultural child rearing.

II. The Literature

The first section of this paper stressed the environmental side of infant-environment interaction. However, the importance of the environment from an individual, developmental standpoint is that it serves as the context in which development happens. Thus, the goal of environmental assessment in the child development literature is most often a better understanding of how differential environments relate to the process of individual development. Lewis and Lee-Painter (1974) discussed the integrity of the infant-environment system in this way: "No one is interested in how many times the cradle rocks in two hours, for we realize, although we never state explictly, that the study of that element in the model makes little sense unless we study it in interaction with another element, namely the infant" (p. 22). For this reason, the studies below are discussed not only in terms of the methods of environmental assessment, but include contemporaneously studied infant variables and the relationships between environmental events and developmental outcome.

Research into the context of development now extends from intra-uterine experience through old age. For purposes of this paper an arbitrary age constraint has been imposed on the extensive literature purporting assessment of environmental contexts: only infant-environment interaction observed between birth and one year were included for review here. A compromise between span of development and depth of analysis was seen as necessary for a manageable review.

The literature within the chosen age constraint was organized along two dimensions. The first of these describes the degree to which the researchers adopted an ecological perspective. In a strict sense, traditional ecological research involves well-defined observational strategies and a broad conceptualization of the natural context of development (e.g., Barker, 1974). No studies of the environments of very young infants were found to follow traditional ecological lines. Therefore, degree of ecological perspective has been described as a continuum, ranging from a very narrow focus on the mother as the infant's sensory environment to a broadly defined, cross-cultural perspective. Studies based on widely disparate perspectives may be designed for very different purposes. A narrow focus may be chosen to allow micro-analytical, fine-grained analyses of subtle organism-environment relationships. However, when viewed from a broader perspective, such relationships may be seen to depend on overriding setting or geographic variables that influence generalizations about the results. The relative breadth of a researcher's focus may influence the choice of variables to observe, and, as Rheingold (1961) stated, "clearly, the decision about what to record constitutes the heart of the problem" (p. 177). Thus, relative position on an ecological continuum may be used as a organizing dimension of the environmental assessment literature. The studies reviewed below will be clustered around three points on that continuum: the social environment, a combination of the social and physical milieu, and a cross-cultural perspective.

The second continuum along which the environmental assessment literature might be ordered involves the researcher's assumptions about the nature of infant-environment interactions. While these underlying models

are not always specified in the research report, the variables chosen and the method by which the variables are analyzed provide clues as to the researcher's interactive model. For example, variables which describe infant activities are chosen to be observed, along with variables which describe maternal behavior directed toward the infant. These variables may be coded in a sequential fashion, such as "infant cries-mother rocks-infant coos-mother smiles." For analysis, however, these infant and maternal activities are split into independent sets of variables (Rosenfeld, 1973). The rates of each infant behavior are then correlated with, or regressed upon the rates of maternal behaviors. Or, the rates of maternal or infant behaviors are related to background variables. Since the original sequence of the partner's behaviors is not retained, a non-sequential model of interaction may be assumed.

Alternatively, the infant and environment can be viewed as a system. A system has been defined as a unit greater than the sum of its parts (Thoman, Acebo, Dreyer, Becker, & Freese, in press). In this case, then, the behavior stream cannot be broken without losing important information. Each behavior is seen as both a stimulus and a response, and so definitions of a behavior as a cause or an effect become arbitrary, as such decisions depend on where you choose to enter the behavioral sequence (Lewis & Lee-Painter, 1974). Studies which employ time-sampling necessarily break this sequence into "observe" and "record" cycles, yet if the variables are themselves interactive, such as "mutual gaze" or "response to distress," some semblence of the interactive flow may be retained. An alternate technique involves continuous recording in which natural units of infant and environmental variables are recorded sequentially in "real time." These

strategies which attempt to preserve the behavioral stream reflect a sequential model of development.

This particular way of differentiating models of interaction is not new. This same continuum has been described elsewhere as ranging from "element to flow" (Lewis & Lee-Painter, 1974), "causal to non-causal" (Thoman, Becker, & Freese, 1977), and "non-systematic to systematic" (Thoman, Acebo, Dreyer, Becker, & Freese, in press). Although the labels vary, these authors have addressed the same continuum of interactive models. While the studies reviewed here have been labeled as reflecting non-sequential or sequential models for organizing purposes, a continuum rather than a dichotomy of interactive models has been assumed. In summary, within the three ecological perspectives outlined above, research was described as favoring a non-sequential or sequential approach toward infant-environment interactions.

A. Social Environment/Non-Sequential Approach

A highly discernible strategy is common to the group of research studies identified with non-sequential model. Specific maternal (and sometimes infant) variables are typically observed in a natural or quasi-natural setting, usually a feeding situation. The rates of these variables evident in individual mother-infant pairs are then correlated with background or demographic variables. However, instead of correlating maternal behavior with a background variable, an experimental manipulation might be made and the rates of maternal and infant behaviors analyzed by condition or group. It turns out that of the studies included in this

group, no two were comparable in terms of variables chosen and samples selected. Although many interesting relationships between maternal behaviors and background variables were noted, no particular result has been replicated; therefore, all the relationships reported must be viewed as tentative.

A study by Richards and Bernal (1971) is prototypical of the social/non-sequential strategy, and so will be discussed in some detail. As part of a larger study of infant development, the authors observed five, five-hour sessions over the infant's first ten days. Time-sampling observations were completed in the homes of sixty mother-infant pairs. Sampled maternal variables included kiss, rock, touch, walk with, talk, smile, stimulate suck, and diapering of the infant, while infant sucking, swaddling, position and position change, and state were also observed. In this comprehensive study, a maternal diary of caretaking events and infant cycles, a maternal attitude questionnaire, and an infant examination were included as supportive data. These maternal and infant variables were then related in a simple frequency analysis to type of feeding (breast versus bottle) and presence or absence of obstetrical medication given during the delivery of the infant.

Breast-fed babies were observed to suck at a higher rate, feed for a longer period of time, and thus be left in their cribs less than bottle-feeders. The only maternal characteristic which related to use of obstetrical medication involved maternal stimulation of infant suck. As infants exposed to such medication were observed to feed for shorter intervals and with more interruptions, Richards and Bernal (1971) concluded that the drugs affected infant behavior more than maternal style. These

conclusions were supported by the infant neurological exam and a rating of the infant's physical status at birth. Because a time-sampling strategy was used, only conclusions about absolute rates of maternal and infant behavior could be drawn. It was not possible to evaluate the effect of medication on maternal behavior since the ordering and patterning of the maternal behaviors in relation to infant behaviors may well have been affected. Such questions cannot be asked if only portions of the behavior sequence are recorded, as in a time-sampling strategy.

Thoman, Leiderman, and Olson (1972) time-sampled similar maternal behaviors during a single feeding observation before the newborn left the hospital. During breast-feeding, water-feeding, and non-feeding interaction sequences, Thoman and her colleagues observed maternal tactile, verbal and smiling stimulation of her infant, and related these variables to birth order and sex of the infant across 40 mother-infant pairs. Significant main effects and interactions between parity and sex of the infant were found, as primiparas (mothers of firstborns) engaged in more non-feeding interactions, and breast-fed their male infants more than multiparas. Female newborns were breast-fed more by multiparas. Stimulation of their infants across modalities, and significantly more talking to their female infants by primiparas was observed. Multiparas talked more if their infants were male. The authors concluded that firstborn infants were generally stimulated more during an early feeding, and noted that breast feeding was continued longer into the first year of life if the infant was firstborn.

A colleague of Thoman investigated similar maternal variables during the mother's first feeding of her newborn in the hospital for 28 pairs

(Gaulin-Kremer, Shaw, & Thoman, 1977). In this study, maternal tactile stimulation (rocking, caressing, and patting) was recorded in a continuous interval procedure. Mutual gaze and vocalizations to the infant were also recorded. These social variables, along with the length of social interaction before feeding, were related to the number of hours between delivery and the first feeding interaction. This separation depended only on the routine of the hospital, and was not related to infant or maternal medical complications. All six variables were negatively correlated with separation interval. Shorter separation intervals related significantly to more caressing and pre-feeding interactions, and marginally to the amount of talking by the mother to her infant. Additional analyses confirmed that no relationships to parity, race, medication, sex of the infant, or type of feeding were confounding the results. Although the authors mentioned that simultaneously recorded infant variables supported their conclusions of significant separation effects on the "emerging mother-infant relationship," the data were not available for critical analysis. By employing continuous interval recording, infant behaviors might have been included in the observation code, preserving the interactive sequence. The significant level of the separation effect with a relatively small sample and restricted range of separation (10 to 25 hours) suggests that a replication within a sequential model of interaction might be worthwhile, to determine specific effects of imposed separation on the interactive relationship.

Early contacts between mothers and newborns were also observed in the hospital by Klaus, Kennell, Plumb, and Zuehlke (1970). They observed maternal fingertip versus palmar exploration of their infants, physical

encompassing, enface positioning, smiling, and talking. Rates at which these variables were directed toward fullterm infants were contrasted with maternal contact of premature, but healthy infants through the portholes of the isolette. Similar progressions from fingertip to palmar caressing of the infants occurred. However, this progression was completed over the first five minutes of contact for fullterm infants, but lasted five days with the premature pairs. Percent of time in the enface postiton increased more quickly in the fullterm dyads, and reached a higher overall level when compared to maternal-premature enface postions. The authors state that the results could well be attributed to an inhibition of maternal behavior due to unfamiliarity with the isolette and premature nursery surroundings, rather than the premature status of the infant per se. Indeed, differential maternal behavior is not suprising under such circumstances. As no infant data were reported, it is difficult to speculate on how infant characteristics associated with prematurity might have interacted with maternal stimulation variables to influence their exchange.

The amount of separation imposed by hospital routines on mothers of premature infants was manipulated by Leifer, Leiderman, Barnett, and Williams (1972). During three observations over the first months of life, maternal proximal and distal stimulation were time-sampled for a premature separated, premature contact, and normal fullterm comparison groups. Amount of contact allowed in the premature nursery had no significant effect on rates of maternal variables during subsequent caretaking and non-caretaking interactions. However, mothers of fullterm infants provided different types of stimulation than mothers of prematures. While premature infants were held more, fullterm infants were touched and provided with

more ventral contact. In terms of distal stimulation, only the "smile" variable differentiated the two premature groups from those born at term, with the low-birth-weight infants being smiled at more. Again, we are uncertain as to how these groups of infants responded to their differential contacts, and how maternal tactile and visual stimulation differences affected the interactive process.

A similar manipulation of early maternal contact was attempted by Klaus and his colleagues (Klaus, Jerauld, Kreger, McAlpine, Steffa, & Kennell, 1972) in a widely-discussed study using 28 lower class, primiparous mothers and their fullterm infants. While a control group saw their infants only at feeding times, the extended contact group was allowed one hour of interaction shortly after birth and five hours of daily rooming-in with their infants throughout their hospital stay. At approximately one month of age, the mother-infant pairs were brought in for an interview, a filmed feeding episode, and a physical exam of the infant. Again, infant variables were not assessed, and the data represent rates of maternal activities. However, the wide range of significant effects found in maternal styles with the relatively short-term intervention has provoked heated discussion of the validity of a human maternal sensitive period concept (Trause, 1977).

Although the distributions of the Klaus et al. (1972) groups overlapped, they differed significantly on the maternal interview, which assessed maternal attitudes towards response to distress and spoiling. More early contact mothers chose to watch their infants' physical exams, and the percentage of the feeding observation spent in fondling and enface was significantly greater than the routine contact group. Although the

authors mention the possiblity of halo or side effects confounding their experimental manipulation, they use little caution in generalizing from their lower class sample to all mothers and infants. Differential infant behavior was not assessed, and so the means by which early contact might influence the interactive sequence was not clarified.

More long term effects on maternal stimulation variables have been assessed within the social/non-sequential framework. Moss, Robson, and Pedersen (1969) chose a variable derived from a prenatal interview---animation of the mother's voice--as a general indication of her desire to stimulate others. Relationships between this variable and subsequent time-sampled observations of maternal proximal and distal stimulation of her infant at one and three months, and with stranger fear measures at eight and nine-and-a-half months were found. A sample size of 54 primiparous pairs, split evenly between male and female infants, allowed analysis of sex differences in maternal behavior toward their infants. One-month-old male infants were rocked, kissed and talked to more if their mother's voices were coded as stimulating in the prenatal interview, while at three months, the variable "kiss" alone was related in this group. Three-month sex differences seemed related to modality of stimulation, as the relationships between prenatal maternal voice animation and later stimulation of the infants' distance receptors (i.e. visual and auditory variables) were much stronger for female infants.

When the infant's response to a stranger's approach was assessed six months later, Moss and his colleagues (1969) found early distal stimulation to correlate negatively with stranger fear and gaze aversion. The process by which different variables assessed longitudinally might be related at

statistically significant levels remains a question, as no interactive sequences were recorded. The authors suggest that perhaps the mothers noted precocious development in their female infants, and matched a more sophisticated distal stimulation style to their daughter's developmental level. The inclusion of contemporaneously studied infant behaviors which tend to precede and follow maternal receptor stimulation might have served to test the authors' hypothesis about the process behind significant variable interrelationships.

As stated at the beginning of this section, few conclusions may be drawn with confidence from this small group of studies. No two researchers have attempted to observe the same variables with similar samples, and so no specific relationship has been replicated. By arbitrarily breaking behavioral units with time-sampling strategies, and analyzing rates of behavioral emission as we might in an experimental laboratory design, the studies do little to increase our understanding of the means by which infant sex differences or maternal separation intervals influence ongoing interactions. Indeed, the infant has been left out of the picture altogether in several of the studies in this section. The statistically significant relationships found between background variables and maternal behavior may suggest that we are choosing the right variables to study, but may be studying them in the wrong way.

B. Social Environment/Sequential Approach

While a common strategy was discernable in the social/non-sequential studies--correlations between rates of maternal and infant behaviors--

researchers have employed a variety of strategies aimed at an objective analysis of the sequence of infant- environment interactions. One tactic which allows a quasi-sequential analysis within a time-sampling framework is the use of code categories which themselves describe small chunks of interaction. Generally, time-sampled data do not allow the congruence or contingency of infant and caregiver events to be reconstructed. One can only state, for example, that within one time unit the infant looked at the mother and the mother looked at the infant. An interaction has not been established. However, if the variable "mutual gaze" is included among the coded events, that variable's occurrence may represent a small interactive event.

Capturing contingencies between infant and environmental events is more difficult with time-sampling. One tactic has been to incorporate variables such as "maternal vocalization contingent upon infant distress" into the code, generally defined as a lag no greater than five seconds long between the maternal and infant behaviors. Several problems with this strategy have been noted. It may be too demanding to ask observers to note elapsed time between coded events, allowing error into the coding of behaviors as "contingent." If a sequential strategy were used, in which the patterning of events in real time were prescribed, analysis of various time lags might be completed more accurately at a later time. Another problem with "contingency" variables involves the nature of the time-sampling cycle. If the infant distress and maternal response fall within the "observe" cycle of a sampling unit, then the contingency may be retained. However, if the infant distress falls at the end of an "observe" cycle, consequent maternal attention will be lost as the observer looks away to

record. If such events occur randomly in time, then a fair picture of maternal contingencies will be observed. However, such random patterning of infant and environmental events has not been proven, and, in general, "mutual" variables fare better than "contingent" ones in time-sampling schemes.

Continuous coding is the obvious solution to catching interactive contingencies. The studies reviewed here have accomplished this goal by either continuous interval paper and pencil techniques or by means of electronic devices which allow simultaneous observing and recording of the behavioral stream. One exception is an early study by Brody (1956) who devised a unique sequential strategy to assess caregiver-infant interactions. Brody observed 32 mother-infant pairs throughout a four-hour office visit, during which a movie of the infant's activity was made. The mother was interviewed about her child-rearing attitudes, and was urged to care for the child as she would at home. Because maternal styles might have been inhibited by the unfamiliar surroundings, a two-hour home visit followed, which included another maternal interview and further observations of unstructured mother-infant interactions. Narrative accounts of these interactive sequences were divided into units which represented single maternal acts, such as feeding, moving, touching or speaking to the infant. This approach should be differentiated from a time-sampling strategy which divides behavioral sequences into arbitrary time units for the observer's convenience. Each unit was then rated on a five-point scale as to its appropriateness to the infant's needs and rhythms. The units were also charted chronologically so that timing and spacing of activities could be analyzed. The mothers were then classified into one of four

groups, determined by their scale ratings. The maternal styles represented by these groups ranged from sensitive, attentive, and consistent care to hypersensitive, hyperactive, and inconsistent care. The maternal style groups were then shown to differ as to parity, bottle versus breast feeding, amount of social interaction during feedings, and the flexibility of their feeding schedules. Brody (1956) might be said to have suceeded in identifying styles of interactions based on both contingencies and patterns of maternal behaviors. She chose to focus on the mother, however, and so her results were discussed in terms of fairly one-sided direction of effects.

Yarrow's early work represents a similar focus on maternal responsiveness to infant behaviors (Yarrow, 1963). Although employing a time-sampling framework, he developed maternal variables which incorporated preceeding infant behaviors, such as speed of response to a need expressed by the infant, and appropriate response to infant attempts at communication. Infant characteristics were derived from observations of the infant in a home context and in structured testing and social situations. Forty infant-caregiver dyads were observed; half of the infants were in adoptive homes, and half in foster homes. The maternal care variables were then correlated with the infant characteristics, and revealed that maternal adaptation of stimulation to the infant's level, stimulation of achievement, communication, and positive emotional expression related most strongly to the various infant measures. Both the amount and quality of maternal stimulation were found to relate to infant IQ with positive correlations in the sixties and seventies. The infant's ability to handle stress related to maternal emotional and physical involvement, sensitivity,

adaptation of stimulation to the infant's individual needs, and general acceptance of the infant as an individual (all defined operationally in the author's text). Thus, the variables which Yarrow classified as representing stimulation-learning conditions related most strongly to the infant IQ measure, while variables described as need-gratifying and affectionate correlated with the infant's observed capacity to handle stress.

Although Yarrow (1963) summarized his data as representing differential effects of specific maternal behaviors on infant development, he concluded that more research on infant effects was needed. "There is a complex relationship between the mother's behavior towards the infant and the infant's basic response patterns, predispostions, and individual sensitivities and vulnerabilities....it is difficult to establish the point of the beginning of the circle" (p. 110).

More recently, several researchers have included interactive variables in their time-sampling codes in order to highlight sequences of infant-caregiver interactions. Beckwith and her colleagues conducted a longitudinal investigation of infants at one, three, and eight months who had been born prematurely (Beckwith, Cohen , Kopp, Parmalee, & Marcy, 1976). Although they time-sampled and analyzed by frequency of events, several interactive categories were included to allow the mutuality and contingency of events to be examined. In addition to classifying the caregiving or social setting of an interaction, the authors coded type and contingency of maternal speech, type of touch and hold, social play, mutual gaze and smile, and response to distress. Another interactive variable called "environmental mediation" included maternal object presentation and

allowance of floor freedom. The rather limited range of infant variables included fussing and crying, and two categories of social response to the observer: smiling and vocalizing.

These variables were then factor analyzed by Beckwith et al. (1976) at each age group, and the factor scores were used in a regression analysis to predict the infant's nine-month Gesell and sensorimotor scale scores. Mutual gaze was the best one-month predictor of the nine-month sensorimotor performance. At three months, the factor describing the infant's attempts at social contact with the observer predicted sensorimotor performance, while maternal control (involving commanding and critical speech directed toward the infant), best explained Gesell score variance. Finally, the best eight-month predictor of Gesell performance was floor freedom allowed the infant, while the amount of mutual social interactions between the mother and her eight-month-old infant predicted sensorimotor performance best. The fact that different clusters of variables were found to predict scores on the two developmental tests suggests that these assessments may evaluate very different behavioral repertoires. Although the multiple correlation coefficients associated with these predictions were respectable, ranging from .32 to .43, the 51 mother-infant pairs observed may not be adequate for a regression analysis (Kerlinger & Pedhazur, 1973), and so the relative importance of these various predictors must be viewed as tentative.

These same data were also analyzed by infant sex and birth order (Cohen & Beckwith, 1975), revealing differential interaction styles between mothers and firstborn, versus laterborn infants. Factor scores were analyzed via analyses of variance for each age period. No significant

differences on factor scores emerged at one month. However, by three months of age, firstborns scored significantly higher on the maternal social responsiveness and the maternal control factors. Only one factor differentiated first and laterborn infants at eight months. Firstborns received more "intellectual stimulation," involving positive verbal and object stimulation. A sex difference was also found, which interacted with birth order on the maternal control factor at eight months. Firstborn girls received the most directives, criticisms, and interference from their mothers. Although infant effects on subsequent maternal behavior were not coded and thus were not able to be analyzed in the Beckwith et al. (1976) and Cohen and Beckwith (1975) reports, both the mutual gaze variable and several small "infant acts-mother acts" chains represented in the contingency variables were shown by the authors to relate to subsequent developmental progress.

Variables and timings of observations similar to those used by Beckwith et al. (1976) were evident in Campbell's (1977) study, although the specific observation strategy employed was not specified by the author. Frequencies of mutual vocalization, response to distress, caregiving, looking, playing with, holding, and vocalizing to the infant were obtained at both three and eight months. Infant variables included vocalization, looking at the mother, laughing, crying, and playing. Campbell observed these variables for five infants who had been asphyxiated at birth and five matched controls. In addition, five infants rated as "difficult" on Carey Infant Temperament Questionnaires, filled out by their mothers at both three and eight months, and their matched controls were also observed.

Campbell reported interesting group main effects and group x time interactions which resulted from an analysis of variance of observed maternal, infant, and interactive behaviors. Asphyxiated infants were played with less, and they looked and smiled at their mothers less. Maternal responsiveness to the asphyxiated group's crying increased between three and eight months, while the same variable showed a decrease over time for control infants. No temperament differences between the asphyxiated and control infants were evident from their Carey Questionnaire data.

Campbell noted additional differences in maternal, infant, and interactive behavior between the "difficult" infants and their controls. Babies rated as difficult by their mothers at three months were talked to less and generally were engaged in less interaction by their mothers than control infants. Significantly less maternal vocalization and contingent responsiveness to infant distress were also observed. Perhaps related to differential social attention, difficult infants played alone more, and the amount of playing increased over time for difficult infants. Questions about the direction of effect here are unanswerable, as maternal perceptions and infant characteristics have a three month history of mutual interaction.

A study by Weatherstone (1976) described subtle forms of organism-environment interplay in the immediate post-partum period, based on observations of a small sample of newborns. In this pilot study, caregiver, infant and interactive events were time-sampled in a nursery, and in a rooming-in situation with the mother. Using an adaptation of Yarrow's time-sampling code (Yarrow, Cain, Pedersen, and Rand, 1975), Weatherstone coded contextual and social stimulation available from all

sources, plus a variety of infant state, vocalization, visual attention, and oral manipulation indices. The interactive variables included mutual gaze, and a contingency subscripting for types of care and caregiver vocalizations.

Significant differences found by Weatherstone (1976) in the hospital and rooming-in situations suggsted important setting effects on infant-environment interactions. As might be expected, more caregiving interactions occurred in the rooming-in situation, with related caregiver proximity and visual focus also increased. Infant state lability also differentiated the settings, as nursery babies tended to jump from sleep to cry states, while rooming-in infants displayed fewer, less drastic swings of state. A related finding was an increase in pacifier use among nursery babies. The studies reviewed in this section may thus be said to indicate that infant-environment reciprocity is evident not only before the infant reaches a year, but also in the first postpartum days. Many of the significant effects of demographic and temperament variables involved the mutual or contingent codes which were incorporated into time-sampling schemes. Continuous observations are a further step toward perserving the behavioral sequence. Whether continuous interval checklists or electronically coded sequences are the data base, mutuality, timing, and spacing of interactive sequences may be analyzed when a continuous observation strategy is employed.

Two studies will be reviewed in which both mutual and contingent variables were shown to be related to socio-economic status (SES). Lewis and Wilson (1972) observed two hours of awake time in 32, three-month-old infants' homes. The homes were chosen to represent a variety of social

classes. Maternal touch, hold, vocalize, look, smile, play, rock, vocalize to others, reading, and watching TV were coded. Infant variables included vocalize, move, fret/cry, play, smile, and make noise. Analysis of frequency distributions revealed more maternal touching in the lower classes, as well as more smiling, playing, looking, reading, and watching TV. The behavioral rates did not vary in an orderly fashion with SES, but the lowest and highest classes showed significant behavioral differences. In terms of mutual behaviors, there were more time intervals in which both mother and infant were acting in the low SES group, yet this difference disappeared when viewed as a function of the amount of infant activity. Maternal behavior contingent upon infant vocalization was shown to differentiate class groups. Low SES mothers were more likely to touch their infants who had vocalized, while a middle class mother's response was typically a vocalization. This relationship was reversed following an infant distress signal, as middle class mothers responded tactually, while lower class infants mothers vocalized. Some evidence of cognitive precocity among lower class infants was evident in a subsequent laboratory assessment of these infants. Infants from low SES homes displayed developmentally advanced behavior in both response decrement and response recovery indices. The authors cited evidence that the higher levels of proximal stimulation received by the lower class infants may be related to early cognitive precocity.

Kagan and Tulkin (1971) conducted a similar study, with 10-month-old infants. Similar maternal and infant variables were coded in a continuous interval fashion, and a laboratory assessment was used as supportive data. These authors also found more reciprocal vocalizations in middle class

dyads, as well as more face-to-face positioning and encouragement of walking. Lower class mothers of these 10-month-olds tended to respond to infant irritability with food. The older age of the infants in Kagan and Tulkin's (1971) study may relate to the differential maternal resonses to distress found here and in Lewis and Wilson (1972). The laboratory findings in the present study support the higher rates of experience with a vocalizing partner observed for middle class infants. When presented with speech tapes, the middle class infants attempted to determine the source of the speech by turning toward the voice more than the lower class infants.

Kagan and Tulkin (1971) suggested an attitudinal basis for the class differences they observed. The process by which maternal attitudes are translated into caregiving interactions is a complicated one which several researchers have attempted to elaborate. These studies tend to employ continuous coding strategies for a common goal: an understanding of the effect of maternal attitudes on the sequence of mother-infant interactions.

Tulkin and Cohler (1973) observed 30 middle class and 26 lower class dyads with a continuous interval scheme when the infants were 10 months old. For a total of two hours, maternal proximity, physical contact, prohibitions, vocalizations, and entertainment of the infant were observed. Infant activities were also observed and used to derive contingency and reciprocity of vocalization, and the amount of time in interactions. A wide range of maternal attitudes towards child rearing were also assessed and related to social class and observed interactions. Lower class mothers tended to believe that more strict control over the infant's aggression was appropriate, were less encouraging of reciprocity, and felt less comfortable in perceiving the infant's needs. The middle class mothers'

attitudes were more related to observed maternal behaviors than were lower class attitudes. Middle class mothers who stated a belief in encouraging reciprocity left their infants in playpens less, were closer to them, and engaged in interactions with them more. Flexible attitudes toward control related to less observed physical and verbal prohibition, and more comfort in infant need perception related to kissing and entertaining the infant as well as to fewer maternal prohibitions. Only two significant attitude-behavior relationships emerged for the lower class mother: control of aggression related to holding the infant, and comfort in meeting needs related to response to distress. Several authors have suggested that lower class mothers may feel they have little control over their infant's development (Lewis & Goldberg, 1969; Tulkin, 1977; Tulkin & Cohler, 1973). The lack of relationships between attitudes and behavior found in lower class mothers may reflect this fatalism, in that lower class mothers may be less likely to act on their beliefs (Tulkin & Cohler, 1973).

While attitudes may influence mother-infant interactions for some dyads, Lessen-Firestone and Jones (1977) attempted to show that interaction patterns could also influence maternal attitudes. By assessing maternal attitudes prenatally and again when the infant reached four months, the authors were able to observe how attitudes changed with increased maternal-infant contact. Continuous interval recording provided observational measures of interactive patterns. In addition, infant individual differences were assessed with the Brazelton exam. Rather than examining attitudes along SES lines, Lessen-Firestone and Jones (1977) chose to investigate parity differences. The prenatal attitude questionnaire revealed that multiparous mothers felt that infants controlled mother-

infant interaction more than women who had not yet had a child. Parity differences were then found in the degree to which the infants' Brazelton scores related to their behavior during feeding. Laterborn infants' motor responses, alertness and orienting showed consistency between the testing and feeding situations, while firstborn infants' behaviors did not.

In discussing these data, the authors stated that "primiparous mothers, who wanted to control interactions with their infants, did not allow the infants' own behavioral tendencies to express themselves" (p. 6). Other processes may also be influencing the way infant Brazelton scores related to feeding interactions. The Brazelton exam employs testers trained to elicit the infant's very best performance (Brazelton, 1973). Inexperienced primiparas may not have known how to alert their infants or get them to orient. This might be interpreted as a lack of control. An assessment of the infant's more typical level of responding may relate better to primiparous interactions (Sullivan & Horowitz, 1978). Alternatively, obstetrical medication, which tends to covary with both parity and infant behavior (Horowitz, Ashton, Culp, Gaddis, Levin & Reichmann, 1977), was not controlled in this analysis. Both maternal inexperience and obstetrical medication might have confounded the attitude-behavior relationship interpreted by Lessen-Firestone and Jones (1977). However, their data do suggest that maternal attitudes change with time. Attitudes of one group of mothers changed following four months of interactive experience with their infants. A sex difference emerged, with mothers of female infants believing in maternal control of interactive sequences, while women who had had a son believed that the infant was in control. This finding may relate to a sex difference in the patterns of

relationships between the infant and maternal behaviors observed at the early postpartum feed. Many more maternal behaviors were related to contemporaneous infant behaviors for female infants. Lessen-Firestone and Jones suggested that early maternal control of female infant behavior led to a belief that such control was possible. A complex system may function between attitudinal and behavioral indices, which only longitudinal designs will serve to clarify.

The social-sequential studies reviewed to this point have been classified as such by including "contingency" or "mutuality" variables in the sampling schemes. In general these variables have been shown to relate to various outcome measures, yet none of these analyses has really addressed the sequential nature of interactive steams. While the events preceding vocalizations and following infant distress have been frequently derived from sampled or continuous intervals, analysis of the entire behavior stream from a sequential viewpoint has revealed many new interactive insights.

Thoman used sequential analysis in what she called a "systems approach" to individual mother-infant interactions (Thoman et al., 1977). While most of the research reviewed here has employed group means to describe interactive patterning, Thoman used group data only as a baseline against which individual pairs might be compared. Twenty firstborns were observed in their homes during four, 7-hour sessions before the fifth week. Developmental assessments were then completed at seven months, 12 months, and 2 1/2 years.

The observation strategy employed by Thoman and her colleagues (1977) was that of continuous interval recording of 75 mother, infant and

interactive behavioral events. The authors then derived 11 more general categories and analyzed for individual differences and consistency across the four observations. All 11 categories showed high test-retest reliability (.50 - .84) and significant individual variation. Three mother-infant pairs were then selected for individual analysis on the basis of the infant's poor performance on the follow-up assessments. All three dyads engaged in less social interaction when compared with the group. Percentage of time involved in social interaction accompanied by tactile/vestibular stimulation or by looking, were also significantly less than the group mean. As social interaction may be dependent on infant state, the authors compared time spent by the three delayed infants in alert or crying states, and compared them to the group mean. No significant differences or trends were found. However, further analysis revealed that mothers of two of the three developmentally delayed infants were shown to engage in more caregiving activities while holding or carrying their infants.

Finally, sequential analyses of one delayed infant and his mother were made. By examining sequences of maternal activities and contemporaneous infant state changes, Thoman et al. (1977) were able to specify and document descriptive accounts of low reciprocity in this pair. The mother was shown to engage in many, quick changes from non-attention to feeding, when compared with the group. Concurrently, the infant was frequently engaged in an unusual, open-eyed REM sleep state. The frequent feeding attempts were thus shorter, and more likely to be unsuccessful, as the mother misinterpreted the infant's ambiguous sleep cues as alertness. This type of retrospective analysis should not be interpreted as

documenting an inevitability of outcome for infants whose interactions appear similar to Thoman et al.'s (1977) delayed infants (Sameroff & Chandler, 1975). The relationships between asynchronous patterns and subsequent developmental delays highlighted by a sequential approach may suggest important variables to include in a prospective longitudinal study.

Using an even more sophisticated analysis, Rosenfeld (1973) has developed time-series programs which permit the identification of mother and infant variables that are contiguous in and across brief time periods. In a lab setting designed to appear home-like, Rosenfeld videotaped a mother-infant dyad through a one-way mirror during the second quarter of the infant's first year. The tapes were then duplicated with the insertion of a digital clock-face, so that any frame could be located in time.

An early descriptive phase yielded all "potentially meaningful" behavioral categories, which were collapsed to 14 variables for time-series analyses. By dividing the 45-minute tapes into four-second units, recurring behaviors found to be significantly related by a time-series analysis were subjected to time-sequence programs to analyze the temporal relationships between variables. Relational histograms described the locations of one variable between initiations of another. From this one can derive causal inferences, dependent upon time contiguities. The resultant data, although not necessarily generalizeable to other mother-infant dyads, revealed that human behaviors could be analyzed objectively, and that video data can aid such an analysis.

Although the continuous interval schemes used by Thoman et al. (1977), her colleagues and others allow all interesting events to be recorded without sampling breaks, two problems with a continuous interval

strategy remain: the patterning of events within an interval cannot be described, and a laborious data transcription and computer coding process prevent immediate data analysis. A technological advance reported by Sackett, Stephenson, and Ruppenthal (1973) has been widely adopted among researchers interested in sequential analysis of interaction patterning. The Datamyte (Electro/General Corporation) is a battery-powered, clipboard-sized device designed for data collection, storage, and direct computer interface. Numeric observation codes are punched into the unit, which automatically logs the elapsed time since the session began. The sequentially-stored codes and times may later be transmitted directly into the computer for immediate analysis.

Brown and her colleagues used the Datamyte device to record 60 maternal and 40 infant variables for 30 minutes during early postpartum feeding observations (Brown, Bakeman, Snyder, Fredrickson, Morgan, and Helper, 1975). The subjects were 45 black, inner city mothers and their infants. The newborns were also examined with selected items from the Graham-Rosenblith scales. Brown included two types of analysis: the more traditional intercorrelations between rates of maternal and infant variables (non-sequential approach) and a conditional probability analysis (sequential approach) of concurrent behaviors made possible by continuous coding in "real time." The latter analysis asks, for example, whether the conditional probability of infant activity given maternal vocalization exceeds the simple probability of infant activity by a significant amount. The test of significance is a z score, which must exceed a chance level (.01 in this case).

The conditional probability analysis indicated that mothers in this sample did not tend to stimulate their infants while feeding them. While eating, the infants were likely to have their eyes open, but be motorically inactive. Maternal tactile stimulation did not tend to co-occur with any specific infant activity, nor did infant behavior change following such stimulation. Slightly different interpretations would have resulted from correlation analysis alone. For example, the significant correlation between infant activity and infant eyes open would have been interpreted as simultaneous infant activity and alertness. The conditional probability analysis, described above, revealed a more complex relationship between these variables.

Bakeman and Brown (1977b) added two types of sequential analysis in this report. "Flow analysis" takes time into account, while "pattern analysis" does not. The flow analysis is based on transitional probabilities between events that simply describe the probability that one state will follow another. Their analysis indicated that mothers of preterm infants tended to be persistent in acting alone, or more likely to follow a mother-alone dyadic state with antoher mother-alone state. Preterms did not tend to continue an infant alone state as much as fullterm infants did. Other analyses also indicated that preterm mothers had to do most of the work in keeping an interaction underway, as they were more likely to break a quiescent state. Both groups of infants were more likely to break a co-acting state, but the tendency was greater for preterms.

The pattern analysis was more episodic in nature, as the number of five-second units in which a state was repeated was ignored. Only changes from one state to a different state were analyzed. The chains of dyadic

episodes were broken into smaller, two- episode chains, and the frequency of each smaller chain was analyzed.

Preterm interactive patterns were more stereotyped than fullterm patterns. The two predominate chains for the preterms were: co-acting to mother-alone, and mother-alone to co-acting. These are predictable in that if the current state of the pair is known, the next state can be guessed fairly accurately. Generally, both the pattern and flow analysis revealed that mothers of preterm and fullterm infants tended to initiate and continue the communications, and the infants joined intermittantly, but this was especially true for the preterm infants.

One final study will be discussed here, which attempted to apply the sequential analytic techniques used by Bakeman and Brown (1977a) to a different problem. Hopkins and Vietze (1977) assigned 104 lower class primiparous mothers to either early postpartum contact, rooming-in, or control groups, to attempt to differentiate the qualitative and quanitita-tive effects of early contact. They then observed an early feeding interaction in the hospital. Maternal proximity and behavior, infant state and behavior, and the setting of the feeding observation were coded by means of a Datamyte. In addition, a Brazelton exam on the infant's third day and the results of a Carey Infant Temperament Questionnaire were included.

In terms of the Brazelton findings, infants in the early contact group scored higher on the "physiological stability in response to distress" a priori Brazelton cluster, but no other significant differences were found. The only significant difference between the contact groups on the Carey Questionnaire was that mothers perceived their infants as being

less distractable if they had had early contact. A frequency analysis of the interactive data showed that the early contact infants were more inactive, less attentive, and were fed more efficiently by their mothers.

The interactive data were then collapsed into dyadic states, as in Bakeman and Brown (1977a). Mother-infant pairs allowed early contact spent less time co-acting, and more time with only the mother acting. From a transitional probability analysis, it appeared that the early contact group was less likely to persist in coacting or infant acting alone states.

Only two variables differentiated the extended contact group. Mothers who roomed-in with their infants perceived their infants as less active on the Carey Questionnaire. The authors analyzed how may items of the Carey the mothers completed, as an indication of interest in the infant. Extended contact mothers completed more of the items than any other group. While the authors interpret these findings as indicative of the positive effects of both early and extended contact, a non-communicative, non-attentive infant may not necessarily facilitate early experience. The Hopkins and Vietze (1977) study does describe one method of applying sequential analyses to a specific question. Hopefully more researchers interested in describing the complexity of an infant's social interactions will choose observation strategies which allow conditional probabilities between events in the behavioral sequence to be examined.

C. Social and Physical Environment/ Non-sequential approach

While the infants' interactions with their mothers may be the most salient events to adult observers, some researchers (White, 1975; Yarrow,

Rubenstein, Pedersen, & Jankowski, 1972) have suggested that a wider focus encompassing both the physical and social setting might describe early environmental contacts more completely. Adoption of an ecological perspective, discussed in the introduction to this review, might be reflected in a variety of research strategies and observational schemes. A researcher might place mother-infant interactions within a wider social context, or attempt to describe environmental objects with which the infant associates. The physical context of the home might be described, or such derived variables as people/room ratios might be related to ongoing social interactions. Generally, if a researcher made any attempt to incorporate aspects of the physical setting or wider social milieu with which the infant has daily contact, that study has been reviewed here. The non-sequential/sequential distinction is maintained, although in general these initial attempts at describing the ecological milieu relied on a non-sequential analysis.

One of the earliest attempts at a wider ecological focus was made by Rheingold (1960, 1961). Following a flurry of studies which evaluated the development of institutionalized infants (Yarrow, 1961), Rheingold attempted to describe the institutional setting, in comparison with homes which were above average in socio-economic status. In her 1960 report, Rheingold analyzed time-sampled observations of 30 caregiver and 12 infant variables over two four-hour periods for five home-reared and five institutionalized 3 1/2 month old infants. Rheingold summarized the differences she found as relating to quantity, rather than quality of care. In the home, caregiving occurred during 37% of the sampled intervals, while institutionalized infants received care during 8% of the intervals.

The number of different caregivers averaged six in the institutional setting, while one or two were more typical in the home, where a wider range of caregiving activities were also observed. A trade-off was found between proximity and number of people comprising the social milieu, as a smaller variety of people were physically closer to the home-reared infants, while more people could be watched by the institutionalized infants from a greater distance. Infant activities were found to depend on the environmental milieu. For example, "bottle in mouth" was coded more in the institution, as the caregivers tended to prop the bottle in the infant's cribs for long periods of time. Infant play activities centered around toys in the home, where more toys were made available. In the institution the infants played with their hands or clothing. No other differences in infant activities were observed by Rheingold (1960). She suggests that perhaps the institutional care she observed was above a minimum stimulation threshold, and that an intermittent reinforcement schedule available to the institutionalized infants was sufficient to maintain their activity level.

Rheingold (1961) then presented similiar data on a larger sample of home-reared and institutionalized infants. Similiar findings were reported for these 30 infants, in that the home provided more stimulation in general (44% of sampled intervals versus 15%), but every caregiving activity observed in the home also occurred in the institution. Again, institutionalized infants were observed in interaction with toys in seven times fewer intervals than in the home, but play with their hands, bottle, clothing, and crib made up for the lack of toys. In this study, the two groups of infants were tested on social and object tests.

Institutionalized infants were more responsive socially in regarding, smiling, and vocalizing to the tester. While there were no differences in manual exploration or regard of objects, institution-reared infants vocalized to the objects and smiled at the tester more during the object test. Again, the author suggested that although her observations were able to highlight environmental differences, the level of stimulation available in the institution was above threshold. Rheingold did suggest that continuous recording of the ongoing stimulus-response sequence might serve to discover the environmental differences which relate to later delayed functioning evident in the institutionalized infants.

Rubenstein (1967) also incorporated environmental objects into her time-sampling code. Observations of maternal attentiveness to the infant, defined as looking, touching, holding, and talking were used to classify mothers as highly attentive, moderately attentive, or showing low levels of attentiveness to their infants. In addition, the author observed the number of intervals in which the mother presented a play opportunity to the infant, and the availability and variety of toys within the infant's reach during each sampled interval. These observations were completed on 44 infants at five months of age, and at six months two structured testing situations were conducted. A toy was presented to each infant, and the infant's reactions to the toy were observed. The toy was then paired with a novel one, and the infants' reactions to this situation were noted. The attentiveness groups were differentiated on these object tests, in that the high-attentiveness and low-attentiveness groups showed significantly different looking, tactile manipulation, and vocalization to the single toy. The high-attentiveness group also differed significantly from the low

and moderate groups in their looking and manipulation of the novel toy when it was presented with a familiar one. While the number of toys available during the home observation did not distinguish the attentiveness groups, both variety of toys and the number of play opportunities presented by the mother were greater for the high-attentiveness versus low- and moderate-attentiveness groups. It is difficult to say from this analysis what role variety of toys played in the infants' manipulation of and vocalizations to the objects presented to them in the testing situation. Both the Rubenstein (1967) and Rheingold (1960, 1961) data do suggest that environmental objects may discriminate infant environments, as social variables have been demonstrated to do.

A more systematic means of describing the physical and social milieu of young infants has been developed by Caldwell and her colleagues. In a report by Elardo, Bradley, and Caldwell (1975), their goal was described as a "valid, reliable, easy-to-administer, observationally based inventory that would provide an index of the quality and quantity of social, emotional, and cognitive support available to a young child (from birth to three years of age) within the home setting" (p. 72). The home stimulation inventory which resulted was composed of 45 scales which may be described by six subscales: a) emotional and verbal responsivity of the mother, b) avoidance of restriction and punishment, c) degree of organization of the physical and temporal environment, d) provision of appropriate play materials, e) maternal involvement with the child, and f) opportunities for variety in daily stimulation. One third of the 45 items are based on maternal report, while the remainder are scored following an hour-long observation period of the mother interacting with the infant in the home

environment. The items are designed to be objectively and reliably answered in "yes" or "no" terms, and the internal consistency and test-retest reliability indices are acceptable.

Elardo et al. (1975) assessed the environments of 77 normal infants, and completed Bayley Mental Scale developmental assessments at both 6 and 12 months. Correlations between the environmental stimulation subscale scores and Bayley Mental Developmental Indices showed that the organization of the physical and temporal environment and opportunities for variety in daily stimulation were the two subscales assessed at six months which related most strongly to both six-month Bayley scores and the 12-month developmental assessment. The correlations ranged from .16 to .26, so that only a small percentage of the Bayley score variance was accounted for although the correlations were statistically significant. A multiple regression analysis revealed that the six subscales could predict the 12-month Bayley scores, with a multiple correlation coefficient of .30. The two subscales from the 12-month environmental assessment which related most clearly to the comtemporaneous Bayley assessment were maternal provision of play materials and maternal involvement. Thus, different aspects of the environment were shown to relate to development at different ages. A provocative "sleeper effect" of the early home environment was revealed when a Binet assessment was completed when the infants reached three years of age. The six month environmental assessment predicted 25% of the Binet score variance, with a multiple correlation coefficient of .54. Although the authors suggested caution in generalizing from their sample of 77 infants, they did draw several conclusions about their home stimulation inventory. The variables included in the inventory may be related to

cognitive development, at least as it is measured by standardized tests. These relationships may not be obvious at the time the environmental assessment is made, but rather might be revealed in longitudinal follow-up tests. Finally, Elardo et al. (1975) suggested more sophisticated cross-lagged correlational or path analyses to determine if the direction of effects between infant and environment, or the possibility of a third variable affecting them both, might be determined.

Many other researchers have made use of Caldwell's home stimulation scales (HOME) in their own studies of infant-environment interactions. Ramey, Mills, Campbell and O'Brien (1975) used the Home scale to determine the levels of stimulation available in the homes of some of their day-care intervention participants. They chose fifteen lower class infants enrolled for eight hours a day in a day care program, and a control group of 15 infants with similar low SES backgrounds. Then 30 infants were drawn from a random sample across all class levels, comprising a total sample of 60 infants. The average age of these infants was 6.8 months, ranging from three to nine months at the time of the home assessment. A multivariate analysis of variance revealed significant group effects for each of the HOME subscales. Orthogonal contrasts indicated that the homes of the random sample were rated higher on the environmental assessment than the home-reared control group. A marginally significant difference between the home-reared lower class infants and those in the day care program was found on one HOME subscale-maternal involvement. Although enrolled in day care most of the day, these infants' environments involved more maternal involvement during times when the mother and infant were together than for the infants reared at home. The authors conclude that these data

contradict the view that day care hinders positive mother-infant interactions, and support a notion that the quality of maternal care must be distinguished from its quantity.

A similar use of the HOME scale with lower class mother-infant dyads was reported by Brown and Bakeman (in press). The characteristics of their sample and design were discussed previously (Brown, Bakeman, Snyder, Fredrickson, Morgan, and Hepler, 1975). These authors used the HOME scale when their sample was 9 months of age, and found generally low overall scores. While these black lower class mothers were judged to be very emotionally and verbally responsive to their infants, the environmental context of their interactions was judged to be hazardous, to have few toys which stimulated eye-hand coordination, no books, music, and to provide no place for the child to store possessions. Also, the mothers did not tend to teach the infants names for objects, or look at books with them, and both physical restriction and physical punishment were evident.

One researcher who had used Caldwell's HOME scale proceeded to devise an alternate environmental scale with a different focus. Wachs developed the Purdue Home Stimulation Inventory (PHSI) because of a concern that the HOME scale did not distinguish social and physical parameters. An early version of the PHSI, designed to describe mainly the physical context of development, was reported by Wachs, Uzgiris, and Hunt (1971) who related the scores to four subscales of the Uzgiris-Hunt Infant Psychological Development Scales, a cognitive assessment based on Piagetian theory. A cross-sectional design was employed, in which children and homes from a variety of socio-economic levels were evaluated at 7, 11, 15, 18, and 22 months. Only the first year data will be discussed here. These

researchers placed "meaningful significance" criteria on the large number of correlations which resulted from this analysis. In order to be reported, the relationships between the various PHSI items and development at any particular age had to be both consistent (80% in the same direction) and abundant (the mean number of significant correlations found plus one standard deviation).

Of the nine PHSI items which Wachs et al. (1971) found to relate to cognitive performance at seven months, four involved some type of environmental overstimulation, and were all negatively correlated with the developmental assessment. This relationship was strongest for lower class infants. The homes' interior decor and colorfulness related to three of the Uzgiris-Hunt scales, while trips to visit neighbors were significantly related to two scales. At 11 months, two of the seven PHSI items which related to contemporaneous cognitive functioning were again measures of sensory overstimulation (an increased level of noise in the home, and an inability by the child to escape noise). A descriptor of the neighborhood, which the authors suggested might be an index of socio-economic status, was also shown to be related to 11-month Uzgiris-Hunt performance. Two other items involved allowance of infant exploration-- the availability of a magazine for the infant to look at, and whether the mother allowed the infant to explore food tactually, and finger-feed. Finally, regular training given the child on developmental skills, and a parent who had had a child development course were also shown to related to the cognitive assessment.

Wachs, Uzgiris, and Hunt (1971) drew conclusions about the nature of intelligence and the importance of the social and environmental context.

The fact that various items from the PHSI scale related to different Uzgiris-Hunt subscales supports a multivariate view of intelligence as composed of several unique processes and abilities. The relationships between cognitive development and auditory overstimulation which continued to be significant through 22 months, suggested that concerns about stimulus deprivation in infancy may not be as well-founded as a stimulus bombardment theory which has been recently discussed in relation to lower class homes (Lewis and Freedle, 1977). Wachs et al. (1971) suggested that the language delays often found in lower-class children may relate to a high level of non-specific, non-contingent auditory overload, by means of "habituation of the arousal aspect of the orienting response to these loud vocal inputs" (p. 310). The replication of this important study with a longitudinal design might serve to provide further evidence that both negative and positive aspects of an infant's physical and social environment relate to some areas of psychological development.

A factor analysis of the PHSI was reported by Wachs, Francis, and McQuiston (1978) based on home assessments of 72 twelve-month- and 64 eighteen-month-old infants. Ten factors were found to measure the infant's physical environment fairly consistently across ages and sexes. These factors include: tactile-visual variety, traffic pattern in home, availability of books and toys, personal space, environmental regularity, noise-confusion potential, availability of household objects and toys, visual variety in the child's room, contact outside of the home environment, and exploratory freedom allowed inside of the home. The authors suggested that the large number of factors resulting from this analysis support a multidimensional view of the physical environment, rather than

the use of global descriptors. They stated that "it may be more useful to specify specific parameters of the environment and develop mini-theories rather than to continue to postulate general theories which do not reflect the nature of the early environment" (p. 7).

Although Wachs (1978) has provided data on infants between 12 and 24 months using his Purdue Home Stimulation Scale, no reports of infant physical environments below one year have yet been published. Future research with this scale may allow us to differentiate the physical parameters which relate to developmental progress.

D. Social and Physical Environment/Sequential Approach

Two studies which have incorporated both a wide focus on an infant's physical and social environment and a sequential analysis have been included here. Clarke-Stewart (1973) observed 36 lower class, firstborn infants in their homes at 9 and 18 months. The author compiled a comprehensive list of maternal, infant, and environmental variables by means of a "natural history phase" described earlier as an ethological method. Narrative accounts of infants in their home environments were compared with previously published codes, and 26 maternal and 23 infant codes were chosen. The following environmental variables were also included: noise level, home decor, number of toys, toy variety, and complexity and the presence of TV or radio during the session. The codes were recorded sequentially in a continuous interval fashion through three half-hour sessions. Infant development was assessed with the Bayley Scales of Infant Development, and subsequent laboratory, Uzgiris-Hunt, and

language assessments, not reported here, were completed. A maternal responsiveness score was then derived from the number of appropriate contingent responses made by the mother to the infant's distress and social signals. This responsiveness score was controlled for how many times the mother had a chance to respond. Also, an effectiveness score was determined by the infant's response to maternal stimulation variables.

Since over 100 variables were observed in total, Clarke-Stewart (1973) chose to consolidate any rated and observed variables which were highly correlated. A frequency analysis was then used to determine how these infants spent their time. Between nine and 13 months, an equal amount of time was spent interacting with the mother (38%) and with objects (37%). While the TV was observed to be on in more than half of the observation sessions, the infants only attended to it an average of 10 minutes per day. Maternal contact comprised most of the infants' social experiences, with visual attention (40%) and verbal stimulation (25%) describing most of that contact. These maternal caregiving variables were factor analyzed to reveal a large "optimal care" factor including positive loadings on verbal stimulation, stimulation with objects, and response to distress, and negative loading on maternal rejection. Racial differences on maternal variables revealed that white mothers looked, talked, and played more with their infants, and were more affectionate. Black mothers tended to be more restrictive, provide more caregiving stimulation, and be more effective (as judged by infant response). A multiple regression analysis was also used to determine which maternal care variables best predicted later infant competence (as determined by the developmental and laboratory assessments). The same variables which comprised the optimal

maternal care factor, described above, were the best predictors of infant competence. Another regression analysis which predicted infant fretfullness found these same maternal variables negatively related to distress. Although one might criticize the use of regression analyses on such a small sample, Clarke-Stewart (1973) suggested their use over univariate techniques in this type of study. Many significant relationships between maternal care variables and infant development may indicate that a general maternal competence factor is involved, and factor analytic or regression analyses may serve to describe such a factor.

In general, Clarke-Stewart found the inanimate objects available to the child did not relate as strongly to later infant competence as did maternal stimulation with objects. The infant's amount of involvement with objects did relate to the number and variety of toys available in these early observations, but infant skill in relating to objects did not. Clarke-Stewart (1973) concluded that objects gain importance in the process of development through maternal mediation of them. She also drew general conclusions as to the nature of infant competence and its relationship to maternal care. Competence was not related to the presence of the mother, or to the amount of caretaking activities, but rather to social stimulation. Maternal responsiveness was the maternal variable that related most to infant competence. It is interesting that this process variable, derived from a sequential record of the unbroken behavioral stream, was perhaps the most pervasive in terms of later indices of infant competence. Clarke-Stewart (1973) suggested that "contingent responsiveness to an infant's behavior does more than reinforce specific behaviors....it creates in the infant an expectancy of control which generalizes to new situations

and unfamiliar people" (p. 71). In summary, she placed her bets for mother-infant intervention on teaching a young mother how to respond in a playful and affectionate way to the infant's communicative behaviors.

A study similar in its scope and range of effects on developmental theory was designed by Yarrow, Pedersen, and Rubenstein (1977). They observed 41 black infants between five and six months of age as they interacted with their primary caregiver in their homes. The "primary caregiver" notion was introduced to cover a range of family situations represented in the sample, but most of the infants were cared for by their mothers. Three hours of alert time were observed on two different days with a time-sampling strategy. Forty-five caregiver and 15 infant categories were observed, which included two contingency variables: response to distress and vocal response to infant positive vocalization. In addition, all objects within reach of the infant were rated in terms of their complexity, feedback potential and variety. A Bayley assessment and tests of exploratory behavior and novelty preference served as the dependent variables in the analyses.

Yarrow and his colleagues analyzed the intercorrelations between their measures, first dividing maternal stimulation variables in terms of their proximal versus distal stimulation properties. While within the proximal and distal groups the intercorrelations were high, between the groups of variables the correlations were low and non-significant. This was also true of the two contingency measures, in that low correlations were found between response to fretful and positive vocalization. Suprisingly, a near-zero relationship between the animate and inanimate aspects of the infant's environment was also found. When these variables

were correlated with infant development, Yarrow et al. (1977) found that while both distal and proximal stimulation related to Bayley performance at six months, proximal showed a stronger relationship. Of the types of proximal stimulation, kinesthetic (which Yarrow defined as body movement in space, usually called vestibular stimulation) showed the strongest relationship. This variable served both soothing and alerting functions for the infant, depending on the infant's initial state. The authors suggested the possibility that the infant's positive response to the mode of stimulation presented by the mother may serve to elicit future stimulation in that mode, and so may affect, as well as be affected by, stimulation type.

The relationship between maternal vocalization contingent upon infant positive vocalization and infant development was limited to infant vocalization during play, yet maternal response to infant distress related to many aspects of infant development. The authors suggested a double benefit to speedy responses to infant distress: freeing the infant to respond to aspects of the environment, and allowing the infant to realize an impact on the environment. However, the large number of significant effects between the ratings of the infant's toys and the developmental indices were perhaps the most provocative findings of this research. While responsiveness and complexity of objects were highly correlated, together they related to the infant's observed reaching, grasping, secondary circular reactions, and manipulation of novel objects. The variety of the objects available to the infant related to almost all of the infant measures, except for social responsiveness and vocalizations. These differential correlations led Yarrow, Rubenstein, Pedersen, and Jankowski

(1972) to propose orthogonal effects of an infant's inanimate and animate environments. While the quality and quantity of objects available to an infant relate to cognitive and exploratory functioning, the social environment influences responsiveness and language development. A complex feedback system was proposed between the infant and all aspects of the environment, resulting in an orientation to new experiences very similar to that suggested by Clarke-Stewart (1973). As the infant is reinforced by attempts to influence the world, the infant's motivation to have an effect on objects and people is increased. A self-perpetuating cycle results, which was related by both Clarke-Stewart (1973) and Yarrow et al. (1977) to measures of infant competence in many areas. Yarrow, Pedersen, and Rubenstein's (1977) theory of the differential importance of the social and physical milieu would not have been possible without an ecological perspective. Similarly, the theory of the infant as both an agent and a recipient of environmental events proposed by both groups of researchers included in this section, might be said to depend on a sequential, process analysis of infant-environment interactions.

E. Cultural Environment/Non-sequential Approach

Attempts to describe infant-environment interactions within a cultural context have been selected to represent the widest focus of the ecological continuum. Within infancy, an extensive cross-cultural literature exists which could provide the material for a lengthy review. Four studies have been selected to represent the flavor of cross-cultural research, two which assume a non-sequential interactive model, and two

falling closer to the sequential end of the interactive continuum.

Konner's (1977) study of the !Kung San, hunter-gatherers in the Kalahari Desert, was based on a rationale similar to Kagan's (1977) discussed in the introduction to this paper. Konner felt that a cross-cultural perspective might allow levels of variables not found in our culture to be observed, or serve to highlight infant-caregiver interactive styles which are universal. The former goal was realized, as the levels of proximal contact found in this group of mothers and babies exceeded levels previously observed in our culture. Konner observed that "if the orphanage infants observed by Rheingold (1960) are 'deprived' of physical contact as compared with infants living at home, then normally reared American infants would appear to be similarly 'deprived' as compared with !Kung infants" (p. 296). This near-constant proximity of mother and infant was observed via continuous interval coding, and a sex difference was revealed in that close physical contact was maintained for longer periods of time with female infants. In order to test a prevalent hypothesis of a trade-off between proximal and distal stimulation in African cultures, Konner (1977) compared rates of maternal vocalizations to a comparable U.S. working class sample (Richards & Bernal, 1971). No differences in vocalizations to infants were found. Konner also discussed child-rearing attitudes with the !Kung San mothers, who felt that infants teach themselves skills except for in the motor area. Infant tests revealed motor precocity when compared with U.S. infants, perhaps related to maternal coaching of motor skills.

Caudill and Weinstein (1969) reported an extensive comparison of U.S. and Japanese mother-infant interactive patterns. In order to differentiate cultural from social class influences on interactive

patterns, these authors selected 30 working class and middle class dyads and matched them with a similar American sample. A time-sampling strategy was used to observe 400, 15-second units a day. Rates of occurrence for 12 infant and 15 caregiver variables were analyzed via multivariate statistical methods to reveal that the infants' culture accounted for most of the variance in interactive behaviors. Only in Japan did social class have an effect. Atypically for a cross-cultural study, Caudill and Weinstein (1969) discussed both similarities and differences between cultures. Infant and caregiver behavior related to the infant's biological needs were similar between the cultures. Social behavior and the subtleties of caregiving styles differentiated Japanese and American dyads. Japanese infants were more "subdued" in terms of activity, vocalizations, and exploratory behavior, and their mothers provided more proximal than distal contact. American mothers looked and chatted at their infants more.

Interesting maternal proximity patterns were also found by Caudill and Weinstein (1969), in that Japanese mothers evidenced frequent "passive proximity," with American mothers choosing to provide care and then move to another room. While social class differences were prevalent when infant-environment interactions were observed within our culture, in this case class differences disappeared when a wider cultural perspective was adopted.

F. Cross-Cultural/Sequential

Goldberg (1977) attempted to incorporate mutuality of mother and infant activity in a study of dyads in urban Zambia. She included both

continuous interval coding of a range of maternal and infant behaviors and Caldwell's home stimulation inventory to describe infant-environment interactions in this African culture. The proximal contact between mothers and infants was high, as in Konner's (1977) study, yet contrary to Konner's sample, a low rate of maternal vocalizations to infants was also found. Goldberg's (1977) co-occurrence analysis indicated that maternal activity coincided with infant eating or crying, and occurred at a higher rate with female Zambian infants. Infants were less active during the more frequent, proximal stimulation, responding with more activity during maternal attempts at distal contact. Infant development was also assessed with the Albert Einstein Scales of Sensorimotor Development. In general, Goldberg (1977) found these Zambian infants to be difficult to test, due to a lack of interest in the testing materials and fear of the tester. Repeated visits and food reinforcers allowed her to determine that few relationships existed between the home inventory and sensorimotor development. Family size, family structure, and degree of Westernization (indicated by home versus hospital birth) related to the Einstein Scales more than the home assessment. Also, Goldberg found that the longer the child was carried in a sling by the mother, the poorer the performance on the sensorimotor scales. All of these statistical relationships may indicate that indices of development standardized on an American sample relate best to maternal caregiving behaviors which are susceptible to Western influence. How these interactive patterns relate to the Zambian infant's adaptation to their own cultural demands may be a different question altogether.

Munroe and Munroe (1971) provided what may be a less culturally-biased index of an infant environment: household density. This variable

was defined as the number of persons over three years of age who either ate or slept in the household. Density was then related to observed infant-environment interactions for twelve, 7- to 13-month olds in Western Kenya. The observed variables included infant and maternal activity and location, plus a contingency variable: latency of response to distress. Strong relationships were found between household density and observed infant holding (.55), and with response to distress (.76). A related variable, latency of response to distress, correlated most strongly (-.90) with the density measure. Such consistent correlations between the derived ecological index and observed maternal interaction variables led Munroe and Munroe (1971) to re-analyze Ainsworth's (1963) data of mother-infant attachment in Ghanda. They found a significant, negative relationship between Ainsworth's measures of attachment and household density. Munroe and Munroe summarized their data with a statement reminiscent of Freedman's hypothesized heirarchy of genetically-determined behaviors. "Perhaps it is accurate to say that ecological variables can strongly influence behavior in many ways but that they are most likely to play a major determining role in areas such as socialization where the cultural plan is unspecified about numerous details" (p.12).

These four studies represent the types of insights into infant-environment interaction that are possible from a cross-cultural focus. Such a perspective may serve to prevent environmental researchers from being "locked in" on the white, middle class American home environment as the most suitable context for development, since optimal development (by our standards) was shown to be evident in cultures representing very different contexts. Cross-cultural work, as exemplified here, serves to

elaborate the variety of infant-environment combinations which allow optimal developmental outcome, as assessed within a culture, to occur.

III. Summary and Conclusions

For purposes of this review, the observational studies of infant-environment interactions have been separated along methodological lines in terms of variable choice and with respect to type of analysis. Beyond a discussion of results in terms of methodologies it is important to consider whether the evidence points to any commonalities in the many research findings and whether replications or directions exist that might provide a conceptual synthesis for this large body of research. In this section, specific research findings will be discussed in relation to issues raised in the introduction. A theoretical rationale was presented for assessing infants in naturally-occurring contexts. An ecological perspective and ethological methods were suggested as means to this end. This section attempts to discern whether available observational data support an "infant-in-context" approach towards understanding the process of development.

A. Environmental assessments and developmental progress

The tactic of observing infants in interaction with their natural surroundings would be supported in the literature if such assessments related strongly to current developmental status, or were predictive of developmental outcome. Several studies included in this review addressed this question. Yarrow (1963) found that the amount and quality of early mother-infant interactions explained up to half of the variance of contemporaneously measured infant IQ. Similarly, Clarke-Stewart (1973) found that the best predictor of over-all infant competence (as measured by both observations and developmental assessments) was an "optimal care"

factor. Both of these investigators described the quality aspects of maternal care as overall responsiveness to the infant's signals, and ability to mediate environmental stimulation to the infant's developmental level, all characterized by a positive emotional tone. Yarrow (1963) and Clarke-Stewart (1973) both hypothesized that these responsive interchanges permitted infants to affect their environment repeatedly and thus be motivated to produce those effects. According to these researchers, the infants' pervasive view of a responsive world was reflected in infant competency measures which related strongly to responsive maternal styles. Bakeman and Brown (1977a) tried to quantify the responsive interchanges described above in terms of the predictability of mother-infant interactions. If an infant's behavior has some effect on the mother repeatedly, and vice-versa, then Bakeman and Brown's content-free predictability index might serve to quantify those mutual effects. When three-month interactive predictability was used to predict developmental outcome at one year (as assessed by the Bayley scales), very little of the Bayley score variance (15%) was explained. Various interpretations of these data are possible. Predictability of an interaction may not be an important factor at three months. On the other hand, for a rapidly changing organism, a nine month lag in data collection may be too long to expect statistically significant relationships. Perhaps an intermediate data point, including both an infant developmental index and an infant-environment interaction observation would describe a non-linear relationship between early interactive predictability and developmental outcome.

Thoman (with Acebo, Dreyer, Becker, and Freese, in press) has presented a sound rationale for attacking continuity and predictability

questions from analyses of individual mother-infant pairs. She stated that behavioral regularity within one dyadic system need not be generalized across individuals to be meaningful, and suggested that intensive, longitudinal observations of small samples should replace large-group designs dependent upon correlational analyses. Thoman, Becker, and Freese (1977) exemplified this approach in their retrospective study of delayed infants. The fact that all three of the infants in Thoman's sample that were developmentally delayed showed differences in both quantity and quality of social interaction, when compared with the group means, suggests that individual analyses can be fruitful. Bakeman (1977) has also suggested a way of describing individual pairs by means of conditional probability statistics. A longitudinal, prospective study might be designed to test hypotheses about specific interactive characteristics relevant to optimal outcomes. The Elardo, Bradley, and Caldwell (1975) study suggested that long-term "sleeper-effects" of environmental assessments may reward such a longitudinal design if the subjects are followed into their preschool years.

B. Environmental assessments and demographic variables

From another perspective, our questions about the efficacy of naturalistic infant-environment interaction observations might be clarified if those interactions were differentiated by infant background variables known to relate to developmental outcome. We know that parity (Zajonc, 1976), perinatal trauma (Davies & Tizard, 1975), prematurity (Klein & Stern, 1971), sex (Kagan & Moss, 1962), and social class (Clarke & Clarke, 1977) all relate to outcome measures. In attempting to understand the process by which these early characteristics might influence developmental

outcome, several reserachers have investigated early interaction patterns as potential mediators of these longitudinal relationships.

Parity related to mother-infant transactions in several studies. Brody (1956), Thoman et al. (1972), Cohen and Beckwith (1975), and Lessen-Firestone and Jones (1977) all found significant differences in the way multiparous and primiparous mothers and their infants interacted. Lessen-Firestone and Jones' (1977) finding of primiparous beliefs in maternal control of interactions may have been supported by their earlier postpartum feeding interactions, although an alternate interpretation was suggested. Cohen and Beckwith (1975) did find more attempts at maternal social control of [illegible] firstborns at three months. Both Thoman et al. (1972) and Brody [illegible] found that primiparous mothers stimulated their infants more. While all of these researchers have suggested or implied that differential maternal experience is responsible for parity differences, presence of siblings in the home may be a confounding factor. The significant parity effects found by Thoman et al. (1972) and Lessen-Firestone and Jones (1977) during the neonatal hospital stay may suggest that maternal experience and not sibling presence is the factor responsible for the parity interaction differences found.

In terms of perinatal trauma, Campbell (1977) found different interaction patterns with infants who had been severely asphyxiated at birth. Levels of social responsiveness were decreased when compared to normal control infants, yet maternal response to infant distress was heightened, and increased over time. This result may relate to differential maternal caregiving behaviors found in premature infant-mother dyads, where maternal concern for the infant's well-being may also be warranted.

Mothers tended to hold their prematures more in the Leifer, Leiderman, Barnett, and Williams (1972) study. In cross-cultural data there is the suggestion that constant maternal carrying occurs in areas with high infant mortality, and that the physical closeness may relate to concern for the infant's health status (Levine, 1977). Thoman et al. (1977) found more holding and carrying with infants who later showed developmental delays. It is impossible to state from these data whether the mother's proximity relates to concerns over past perinatal trauma or concurrent infants signals perceived by her. The data from Bakeman and Brown's collaborative research efforts indicate an interaction of effects. While the degree of perinatal trauma was a better predictor of developmental outcome for mothers and their preterm infants than an interactive predictability measure, their interaction patterns also differed significantly from those of full-term dyads (Bakeman & Brown, 1977a, 1977b). Mothers of preterm infants had to work harder to get interactions going, and their infants terminated interactions more than initiating them. Klaus et al. (1970) reported that a mother's first contacts with her premature infant progress differently than in fullterm dyads. Maternal concern for her infant's outcome may magnify behavioral differences in infants with perinatal trauma, leading to early reciprocal patterns which are distinguishable from normal dyadic communications. Again, observed infant-environment interactions may provide a bridge by which infant background characteristics relate to developmental outcome.

Sex differences in developmental progress may be another area where observations of infants in their natural contexts have clarified outcome indices. The Moss, Robson, and Pedersen (1969) finding of early maternal

stimulation of their female infant's distance receptors was related to developmentally advanced responses to a stranger six months later. While Lessen-Firestone and Jones (1977) interpreted their data as evidencing more interactive adaptability in female infants, Cohen and Beckwith (1975) reported a more concrete finding: more mothers attempted to control their female infants with criticisms, directives, and interferences in their eight-month observations. If a longitudinal follow-up of these observations were to relate these interactive patterns to developmental outcome, a clue to the advanced developmental progress documented in females may be found.

Another well-known, yet little-understood developmental phenomenon is the relatively poor developmental progress found in lower class, black children. Several studies reviewed in this paper have attempted to clarify the process by which class membership may affect developmental outcome via interactive patterns. In terms of specific interactive behaviors, one finding has been well-replicated: lower class, black mothers provide more contingent and non-contingent proximal stimulation, while middle or upper class white mothers tend to provide stimulation of their infant's distance receptors (Clarke-Stewart, 1973; Kagan & Tulkin, 1971; Lewis & Wilson, 1972; Moss et al., 1969). One early research team, studying the development of African infants, hypothesized that early abundant proximal stimulation may lead to initial precocity in sensorimotor development which is not maintained after the first two years of life (Gerber & Dean, 1957a, 1957b).

Many other findings have also differentiated lower class homes, including two different environmental inventories, summarizing the social and physical environment (Ramey et al., 1975) and just physical parameters

(Wachs, Uzgiris, & Hunt, 1971). Yet, despite what differences may be found, the question as to why these interactive patterns covary with SES remains. Tulkin and Cohler (1973) hypothesized maternal attitude differences, but found that observed interactions did not relate to attitudes in low SES homes. Their suggestion of a cultural transmission of a fatalistic or powerless attitude as a pervasive factor in mother-infant interactions may be conceptually tight but difficult to test experimentally. Graves and Glick (1978) provided an hypothesis to explain observed interactive differences which may be more testable. After they found highly significant "observer effects" on the interactive sequences of white middle class mothers, they suggested that a mother's conception of what the observer wants to see may determine what is observed. Differential interactive patterns may be quite simply related to what the mother thinks the observaer wants her to do, or whether she feels that a change in her behavior is appropriate in the situation or not. Graves and Glick (1978) suggested that there may be subcultural differences in maternal perception of the task demands in an observational situation. Finally, Wachs, Uzgiris, and Hunt (1971) hypothesized that the high level of non-responsive, non-contingent background noise which they observed to be present in lower class black homes may hinder optimal development. Of these hypotheses, the Graves and Glick (1978) and Wachs et al. (1971) might certainly be tested to clarify the controversial issue of SES differences in early interactions.

In summary, the data reviewed here have supported the position presented in this paper's introduction of using environmental assessments as mediating variables in long-term relationships between demographic and

outcome measures. While many researchers found the general strategy of naturalistic observations of the infant to be useful, specific means of approaching this problem were found to be quite variable. The first section of this paper suggested that an ecological perspective might be well-suited to questions about the context of development. The studies reviewed here might be examined to determine the extent to which an ecological perspective has been achieved in the observational research.

C. Usefulness of an ecological perspective

While progress has been made from the historically applied labels of environments as "deprived," traditional ecologists such as Barker (1963) or Gump (1973) would probably describe very few of the attempts at environmental assessment reviewed here as ecological. License was taken to place the traditional ecologists' view at one end of a continuum described as breadth of environmental focus. Many researchers chose to limit their observations to the infant's interactions with the mother. While maternal styles and mother-infant reciprocity were shown to differentiate infants grouped by parity, sex, etc., subsequent strategies incorporating a wider focus indicated that developmental contexts included much more than social variables. Beginning with Rheingold's early work (1960, 1961), the physical and wider social setting of young infants was observed. This type of perspective is more in line with a traditional ecological strategy in which both passive qualities of the environment and infant-environment interactions are included as observable variables (Gump, personal communication).

In general, the wider the perspective on what constitutes a developmental context, the more outcome measures were shown to relate to

numerous, often orthogonal aspects of the environment. Yarrow et al. (1977) found that social and physical aspects of the environment both related strongly to developmental outcome, but in very different ways. Similarly, Wachs et al. (1971) also found that various aspects of the environment related differently to various subscales of their Piagetian outcome measure. In terms of assessing various qualities of infant environments in a standard way, both Caldwell (Elardo et al., 1975) and Wachs (with Uzgiris & Hunt, 1971) have provided easily-administered scales which allow comparable home data to be collected by many researchers.

At least two important findings have emerged so far from the home environment scales. Elardo et al. (1975) found their HOME scale to distinguish between lower class homes, suggesting that global descriptors may be misleading. A factor analysis of the Wachs scale suggested a multidimensionsal character of the physical qualities of the home, as 10 consistent factors emerged. Thus, a broader, multidimensional perspective on what constitutes and infant's environment has shown that not only are responsive and adaptable social contacts important in an early environment, but various and responsive physical settings, which stop short of sensory overstimulation, have also been shown to relate to developmental outcome. Yet a comprehensive observation of the home environment alone is incomplete unless infant individual differences in effects on and responses to environmental variables are simultaneously assessed. Here again the traditional ecological view is helpful in understanding the organism and surrounding milieu as a system, making observations of the infant or the environment alone uninterpretable.

Several studies reviewed here indicated that infant individual differences, whether assessed in a structured testing or natural situation, interact with environmental variables in a complex fashion (Bakeman & Brown, 1977a, 1977b; Clarke-Stewart, 1973; Yarrow, 1963). Thus, interpretations of environmental assessment data should be tempered by an infant's reponse to and effect on the social, physical, and cultural context. For example, an environment which is in a constant state of unorganized turmoil may relate very differently to an infant who is "slow to warm up" to new people, places, and objects than one who is "easygoing" (as judged, perhaps , by the Carey Questionnaire). Thus, generalizations about the importance of environmental pattern to developmental outcome must be understood to depend on infant differences. An evaluation of the data reviewed here suggests that the use of a sequential observation strategy tends to covary with inclusion of the infant in a systematic approach.

By definition, a sequential approach incorporated infant variables into the stream of environmental activity. All of the studies labeled here as favoring a sequential view attempted to relate ongoing infant and environmental variables. On the contrary, every study which excluded the infant (Klaus, Kennell, Plumb, & Zuehlke, 1970; Moss, Robson, & Pedersen, 1969; Thoman, Leiderman, & Olson, 1972) was a non-sequential one. By maintaining the integrity of the behavioral stream, even small "chunks" of it through mutual or contingent variables, the process by which infant and environment interrelate was clarified. This is not to deny a functional place for the non-sequential study. By discovering strong correlations between large sets of infant and environmental events, more detailed sequential analyses may be determined. Indeed, some of the researchers

listed above as applying a non-sequential interactive model to their early research have adopted a more sequential approach in their current work (e.g. Thoman et al., in press). However, the data presented by Brown et al. (1975) indicated that correlational analyses must not be interpreted too directly, for when the sequence of events is investigated, more complex variable interrelationships may be found.

D. Usefulness of ethological theory

While an ecological perspective was suggeted in this paper's introduction as an appropriate approach to studying development-in-context, ethological theory and methods were suggested as applicable to infant-environment phenomena. Just as few obvious ties to traditional ecology were found, no study reviewed here actually followed traditional ethological lines. However, certain of these studies may be interpreted via ethological theory, and many methodological similarities may be seen.

Survival value was discussed as a pervasive factor in an ethologist's interpretation of behavioral patterns. This concept was not limited to physical survival, but encompassed a range of social or psychological functioning. The premature infant, at known risk for physical and emotional development, was the target of several studies reviewed here. A concensus was obvious that interaction patterns found in preterm pairs differed from those in fullterm dyads (Bakeman & Brown, 1977a, 1977b). The preterm pairs engaged in fewer interactive behaviors generally considered to be indicative of an optimal mother-infant relationship (e.g. enface positioning, ventral contact, mutual responsiveness). While these authors may have clarified early interactive patterns which precede inadequate caregiving and subsequent infant outcome, the lack

of longitudinal follow-up in these studies makes such a statement tenuous.

Another line of research suggested by the animal ethology literature involves the effect of maternal-infant separations shortly after birth. As studies with animal populations have suggested decreased survival chances for separated offspring (Newton & Levine, 1968), several researchers attempted to show similar effects on human "bonding" due to separations imposed by hospital routines (Gaulin-Kremer et al., 1977), experimental manipulations (Hopkins & Vietze, 1977; Klaus et al, 1972; Leifer et al., 1972) and maternal choice to remain in contact with her newborn infant (Weatherstone, 1976). In general, all supported an early contact notion, at least in terms of differential interactive patterns. Outcome indices have been provided by only the Klaus and Kennell group (Fanaroff, 1977) with controversial results. One exception is the Leifer et al. study (1972) which found no effect of early contact allowed with premature infants. Whether the wider premature environmental context (the intensive care unit) inhibited mother-infant interactions is not known. Again, one can only conclude that until long-term follow-up measures are incorporated into early experience research, few direct statements about the survival value of early environmental contacts can be made.

One final perspective was discussed in the introduction as essential to an ethological interpretation of infancy research. A consideration of the evolutionary significance of early environmental contacts has been related to the infancy area by Freedman (1974) in terms of a heirarchy of hereditary and environmental influences. It was suggested that infant's basic mental abilities and levels of perceptual functioning may not be as subject to environmental pressures as social behaviors. Freedman (1974)

suggested that the latter class of behavior may be genetically pre-programmed to be adaptable to variant cultural demands.

Several problems exist in attempting to evaluate the data reviewed here in terms of support for Freedman's (1974) views. The available data are certainly not extensive enough to allow a discussion of species evolution at a population level. In addition, the outcome variables chosen by these infant-environment researchers do not correspond with Freedman's (1974) hypothesis. No researcher actually chose to relate primary mental abilities or perceptual constancy to early experience measures. Two studies did specify relationships between early socially responsive environments and later social precocity (Moss, Robson, & Pedersen, 1969; Yarrow, Rubenstein, Pedersen, & Jankowski, 1972), providing some suggestion of support for Freedman's (1974) tenent that social behaviors are malleable.

However, most of the studies reviewed here which attempted to relate early experience to developmental outcome chose a sensorimotor scale as the outcome measure. As sensorimotor scales involve a blend of cognitive, fine motor, and social behaviors, these data are difficult to align with Freedman's hypothesis. Scarr-Salapatek (1976) has provided another interpretation of infant development from an evolutionary perspective, in which she hypothesized that all "non-defective" members of the human species attain sensorimotor competence by the end of the second year. Rates of progression through the sensorimotor levels may vary, but a similar level of competence is generally attained. The data reviewed here might be said to support this evolutionary interpretation, in that in general only short-term gains in sensorimotor competence have been shown to

relate to early environmental contacts.

Beckwith, Cohen, Kopp, Paramalee, and Marcy (1976) found that the infant's social context as assessed at one, three, and eight months predicted nine-month sensorimotor performance significantly. Both Caldwell's (Elardo, Bradley, & Caldwell, 1975) and Wachs' (Wachs, Uzgiris, & Hunt, 1971) home environmental assessment scales related to infant performances at about a year of age. Although Clarke-Stewart (1973) did not use a sensorimotor scale per se, her infant competence factor included many behaviors assessed by these scales, and was shown to relate strongly to an early responsive environment. Yarrow, Pedersen, and Rubenstein's (1977) data related the complexity and variety of toys in the early home environment to later sensorimotor scores.

While these studies do show strong relationships between early environments and sensorimotor performance, the lack of longitudinal follow-up measures precludes any statement about the eventual achievement of sensorimotor competence (regardless of early experiential differences) by age two. Although this review was limited to relationships between early environments and infant development through one year, only two studies were found which extended their assessments longitudinally through two or three years of age (Elardo, Bradley, & Caldwell, 1975; Wachs, Uzgiris, & Hunt, 1971). Both of these studies found that the relationships did continue through 36 months and 22 months, respectively. More longitudinal research is needed to determine whether continuity exists between early gains in infant competence and later developmental status.

E. Suggestions for future research

The impedence to definitive conclusions about the importance of early environmental variables due to lack of longitudinal data may be the most pervasive criticism of the data reviewed here. Most of our data describing long-term effects of early experiences stem from retrospective accounts of developmentally delayed children. Sameroff and Chandler (1975) have provided an excellent rationale for longitudinal, prospective research. They suggested that retrospective studies, although simpler and more economical, may lead to biased conclusions in that only deficient individuals are studied. Longitudinal, prospective studies allow early characteristics or environmental variables to be used as independent variables, with later outcome as the dependent variable. In this way, individuals whose outcomes are not affected by adverse early environments may also be investigated. Thus, prospective, longitudinal research designs are suggested for further clarification of the role of early environmental interactions in developmental outcome.

The selection of a sequential observation strategy has also been supported by the data reviewed here. In general, such an approach was found to clarify our understanding of the importance of early developmental contacts by incorporating both infant and environmental variables in an ongoing, process-type approach to the complex nature of early interactions. Thus, a second suggestion for future environmental research designs would be to incorporate some means of recording both environmental and infant variables in a sequential fashion within a "real time" framework.

Finally, the adoption of a broad, ecological perspective was shown to enhance an understanding of early environmental variables which may

contribute to developmental outcome. Although from a practical standpoint, a longitudinal design incorporating a sequential analysis of a broad spectrum of environmental variables is understood to be costly, the data reviewed here suggest that our questions about the importance of the early environment may only be answered from such an approach. Prior to the instigation of any intervention program, an urgent obligation exists to thoroughly understand the long-term effects of early experience on the process of development.

References

Ainsworth, M.D. The development of infant-mother interaction among the Ghanda. In B.M. Foss (Ed.), Determinants of infant behavior (Vol. 2). New York: Wiley, 1963.

Bakeman, R. Untangling streams of behavior: Sequential analyses of observational data. In G.P. Sackett (Ed.), Observing behavior (Vol. 2). Baltimore: University Park Press, 1977.

Bakeman, R. & Brown, J.V. Mother-infant interaction during the first months of life: Differences between preterm and fullterm infant-mother dyads from a low-income population (Technical Report 5). Atlanta: Georgia State University, 1977a.

Bakeman, R. & Brown, J.V. Perinatal risk, mother-infant interaction, and early developmental outcome of preterm and fullterm infants. Paper presented at the biennial meeting of the Society for Research in Child Development, New Orleans, March, 1977b.

Barker, R.G. The stream of behavior: Explorations of its structure and content. New York: Appleton-Century-Crofts, 1963.

Barker, R.G. Wanted: An eco-behavioral science. In E.P. Willems & H.L. Rausch (Eds.), Naturalistic viewpoints in psychological research. New York: Holt, Rinehart and Winston, 1969.

Barker, R.G. The ecological environment. In R.H. Moos and P.M. Insel (Eds.), Issues in social ecology. Palo Alto, California: National Press

Books, 1974.

Beckwith, L., Cohen, S.E., Kopp, C.B., Parmalee, A.H., & Marcy, T.G. Caregiver-infant interaction and early cognitive development in pre-term infants. Child Development, 1976, 47, 579-587.

Brazelton, T.B. Neonatal behavioral assessment scale. Philadelphia: J.B. Lippincott, 1973.

Brody, S. Patterns of mothering. New York: International Universities Press, 1956.

Brown, J.V., & Bakeman, R. Relationships of human mothers with their infants during the first year of life: Effects of prematurity. In R.W. Bell & W.P. Smotherman (Eds.), Maternal influences and early behavior. Holliswood, N.Y.: Spectrum, in press.

Brown, J.V., Bakeman, R., Snyder, P.A., Fredrickson, W.T., Morgan, S.T., & Hepler, R. Interactions of black inner-city mothers and their newborn infants. Child Development, 1975, 46, 677-686.

Caldwell, B.M. Descriptive evaluations of development and of developmental settings. Pediatrics, 1967, 40, 46-54.

Campbell, S.B. Maternal and infant behavior in normal, high risk and "difficult" infants. Paper presented at the biennial meeting of the Society for Research in Child Development, New Orleans, March, 1977.

Casler, L. Maternal deprivation: a critical review of the literature. Monographs of the Society for Research in Child Development, 1961, 26,

(2).

Caudill, W., & Weinstein, H. Maternal care and infant behavior in Japan and America. Psychiatry, 1969, 32, 12-43.

Charlesworth, W.R. Developmental psychology and human ethology. Society for Research in Child Development Newsletter, Winter, 1975.

Clarke, A.M., & Clarke, A.D.B. Problems in comparing the effects of environmental change at different ages. In H. McGurk (Ed.), Ecological factors in human development. New York: North-Holland, 1977.

Clarke-Stewart, K.A. Interactions between mothers and their young children: Characteristics and consequences. Monographs of the Society for Research in Child Development, 1973, 38 (6-7).

Coher, S.E., & Beckwith, L. Caregiving behaviors and early cognitive development as related to ordinal position in preterm infants. Paper presented at the biennial meeting of the Society for Research in Child Development, Denver, 1975.

Darwin, C. A biographical sketch of an infant. Mind, 1877, 2.

Davies, P.A., & Tizard, J.P.M. Very low birth weight and subsequent neurological defect. Developmental Medicine and Child Neurology, 1975, 17, 3-17.

Dennis, W., & Najarian, P. Infant development under environmental handicap. Psychological Monographs, 1957, 71 (7, Whole No. 436).

Dennis, W., & Sayegh, J. The effect of supplementary experiences upon the behavioral development of infants in institutions. Child Development, 1965, 36, 81-90.

Elardo, R., Bradley, R., & Caldwell, B.M. The relationship of infants' home environments to mental test performance from six to thirty-six months: A longitudinal analysis. Child development, 1975, 46, 71-76.

Fanaroff, A. Maternal-paternal infant bonding. Paper presented at Newborn Behavior Conference, St. Louis, June, 1977.

Freedman, D. Human infancy: An evolutionary perspective. Hillsdale, New York: Lawrence Erlbaum, 1974.

Gaulin-Kremer, E., Shaw, J.L., & Thoman, E.B. Mother-infant interaction at first prolonged encounter: Effects of variation in delay after delivery. Paper presented at the biennial meeting of the Society for Research in Child Development, New Orleans, March, 1977.

Gerber, M., & Dean, R.F.A. Gesell tests on African children. Pediatrics, 1957a, 6, 1055-1065.

Gerber, M., & Dean, R.F.A. The state of development of newborn African children. Lancet, 1957b, 1216-1219.

Gewirtz, H.B., & Gewirtz, J.L. Caretaking settings, background events, and behavioral differences in four Israeli child-rearing environments: Some preliminary trends. In B.M. Foss (Ed.), Determinants of infant behavior (Vol. 4). London: Methuen & Co., Ltd., 1969.

Goldberg, S. Infant development and mother-infant interaction in urban Zambia. In P.H. Leiderman, S.R. Tulkin, & A. Rosenfeld (Eds.), Culture and infancy: Variations in the human experience. New York: Academic Press, 1977.

Graves, Z.R., & Glick, J. The effect of context on mother-child interaction: A progress report. The Quarterly Newsletter of the Institute for Comparative Human Development, 1978, 2, 41-46.

Gump, P.V. Reflections on four ecological studies or how to get where we ought to be going, research-wise. Paper presented at the meeting of the American Psychological Association, Montreal, 1973.

Gump, P.V., & Kounin, J.S. Issues raised by ecological and "classical" research efforts. Merrill-Palmer Quarterly, 1960, 6, 145-152.

Hebb, D.O. The organization of behavior. New York: Wiley, 1949.

Hollenbeck, A.R. Problems of reliability in observational research. In G.P. Sackett (Ed.), Observing behavior (Vol. 2). Baltimore: University Park, 1977.

Hopkins, J.B., & Vietze, P.M. Postpartum early and extended contact: Quality, quantity or both? Paper presented to the biennial meeting of the Society for Research in Child Development, New Orleans, March, 1977.

Horowitz, F.D. Stability and instability in the newborn infant: The quest for illusive threads. In A. Sostek (Chair), Behavioral organization in the newborn: Perspectives and correlates. Symposium presented at the biennial meeting of the Society for Research in Child Development, New

Orleans, March, 1977.

Horowitz, F.D., Ashton, J., Culp, R., Gaddis, E., Levin, S., & Reichmann, B. The effects of obstetrical medication on the behavior of Israeli newborn infants and some comparisons with Uraguayan and American infants. Child Development, 1977, 48, 1607-1623.

Hunt, J. McV. Intelligence and experience. New York: The Roland Press Co., 1961.

Hunt, J. McV. Environmental programming to foster competence and prevent mental retardation in infancy. In R. Walsh & W.T. Greenough (Eds.), Environments as therapy for brain dysfunctions. New York: Plenum, 1976.

Jones, N.B. Ethological studies of child behavior. New York: Cambridge University Press, 1972.

Kagan, J. Change and continuity in infancy. New York: Wiley, 1971.

Kagan, J. The uses of cross-cultural research in early development. In P.H. Leiderman, S.R. Tulkin, & A. Rosenfeld (Eds.), Culture and infancy: Variations in the human experience. New York: Academic, 1977.

Kagan, J., & Moss, H.A. Birth to maturity. New York: Wiley, 1962.

Kagan, J., & Tulkin, S.R. Social class differences in child rearing during the first year. In H.R. Shaffer (Ed.), The origins of human social relations. London: Academic, 1971.

Kerlinger, F.N., & Pedhazur, E.J. Multiple regression in behavioral research. New York: Holt, Rinehart and Winston, 1973.

Klaus, M.H., Kennell, J.H., Plumb, N., & Zuehlke, S. Human maternal behavior. Pediatrics, 1970, 46, 187.

Klaus, M.H., Jerauld, R., Kreger, N.C., McAlpine, W., Steffa, M., & Kennell, J.H. Maternal attachment: Importance of the first postpartum days. New England Journal of Medicine, 1972, 286, 460-463.

Klein, M., & Stern, L. Low birthweight and the battered child syndrome. American Journal of Diseases of Children, 1971, 122, 15-18.

Konner, M. Infancy among the Kalahari Desert San. In P.H. Leiderman, S.R. Tulkin, & A. Rosenfeld (Eds.), Culture and infancy: Variations in the human experience. New York: Academic, 1977.

Lamb, M.E. Fathers: Forgotten contributors to child development. Human Development, 1975, 18, 245-266.

Lamb, M.E. A re-examination of the infant social world. Human Development, 1977, 20, 65-85.

Leiderman, P.H., Tulkin, S.R., & Rosenfeld, A. Looking toward the future. In P.H. Leiderman, S.R. Tulkin, & A. Rosenfeld (Eds.), Culture and infancy: Variations in the human experience. New York: Academic, 1977.

Leifer, A.D., Leiderman, P.H., Barnett, C.R., & Williams, J.A. Effects of mother-infant separation on maternal attachment behavior. Child Development, 1972, 43, 1203-1218.

Lessen-Firestone, J.K., & Jones, D.C. Maternal attitudes and mother-infant interaction: Patterns of reciprocal influence. Paper presented at the

Society for Research in Child Development, New Orleans, March, 1977.

Levine, R.A. Child rearing as cultural adaptation. In P.H. Leiderman, S.R. Tulkin, and A. Rosenfeld (Eds.), Culture and infancy: Variations in the human experience. New York: Academic, 1977.

Lewis, M., & Ban, P. Variance and invariance in the mother-infant interaction: A cross-cultural study. In P.H. Leiderman, S.R. Tulkin, & A. Rosenfeld (Eds.), Culture and infancy: Variations in the human experience. New York: Academic, 1977.

Lewis, M., & Freedle, R. The mother and infant communication system: The effects of poverty. In H. McGurk (Ed.), Ecological factors in human development. New York: North-Holland, 1977.

Lewis, M., & Goldberg, S. Perceptual-cognitive development in infancy: A generalized expectancy model as a function of the mother-infant interaction. Merrill-Palmer Quarterly, 1969, 15, 81-100.

Lewis, M., & Lee-Painter, S. An interactional approach to the mother-infant dyad. In M. Lewis & L.A. Rosenblum (Eds.), The effect of the infant on its caregiver. New York: Wiley, 1974.

Lewis, M., & Wilson, C.D. Infant development in lower-class American families. Human Development, 1972, 15, 112-127.

Moss, H.A. Methodological issues in studying mother-infant interactions. American Journal of Orthopsychiatry, 1965, 35, 482-486.

Moss, H.A., Robson, K.S., & Pedersen, F. Determinants of maternal stimulation of infants and consequences of treatment in later reactions to strangers. Developmental Psychology, 1969, 1, 239-247.

Munroe, R.H., & Munroe, R.L. Household density and infant care in an East African society. Journal of Social Psychology, 1971, 83, 3-13.

Newton, G., & Levine, S. Early experience and behavior. Springfield, Illinois: Charles C. Thomas, 1968.

Omark, D. Ecological factors and ethological observations. In H. McGurk (Ed.), Ecological factors in human development. New York: North-Holland, 1977.

Piaget, J. The child and reality. New York: Vicking, 1973.

Ramey, C.T., Mills, P., Campbell, F.A., & O'Brien, C. Infants' home environments: A comparison of high-risk families and families from the general population. American Journal of Mental Deficiency, 1975, 80, 40-42.

Rheingold, H. The measurement of maternal care. Child Development, 1960, 31, 565-575.

Rheingold, H.L. The effect of environmental stimulation upon social and exploratory behavior in the human infant. In B.M. Foss (Ed.), Determinants of infant behavior (Vol. 1). New York: Wiley, 1961.

Richards, M.P.M. An ecological study of infant development in an urban setting in Britain. In P.H. Leiderman, S.R. Tulkin, & A. Rosenfeld

(Eds.), Culture and infancy: Variations in the human experience. New York: Academic, 1977.

Richards, M.P.M., & Bernal, J.F. Social interaction in the first days of life. In H.R. Schaffer (Ed.), The origins of human social relations. London: Academic Press, 1971.

Rosenfeld, H. Time-series analysis of mother-infant interaction. Paper presented at the biennial meeting of the Society for Research in Child Development, Philadelphia, April, 1973.

Rubenstein, J. Maternal attentiveness and subsequent behavior in the infant. Child Development, 1967, 38, 1089-1100.

Sackett, G.P., Stephenson, E., & Ruppenthal, G.C. Digital data acquisition systems for observing behavior in laboratory and field settings. Behavioral Research Methods and Instrumentation 1973, 5, 344-348.

Sameroff, A.J., & Chandler, M.J. Reproductive risk and the continuum of caretaking casualty. In F.D. Horowitz (Ed.), Review of child development research (Vol. 4). Chicago: University of Chicago Press, 1975.

Scarr-Salapatek, S. An evolutionary perspective on infant intelligence: Species patterns and individual variations. In M. Lewis (Ed.), Origins of intelligence. New York: Plenum, 1976.

Skeels, H.M. Adult status of children with contrasting early life experiences. Monographs for the Society for Research in Child Development, 1966, 31 (3, Serial No. 105).

Skeels, H.M., & Dye, H.B. A study of the effects of differential stimulation of mentally retarded children. Proceedings of the American Association of Mental Deficiency, 1939, 44, 114-136.

Spitz, R.A. Hospitalism: An inquiry into the genesis of psychiatric conditions in early childhood. Psychoanalytic Study of the Child, 1945, 1, 53-74.

Sullivan, J., & Horowitz, F.D. Kansas supplement to the Neonatal Behavioral Assessment Scale: A first look. Paper presented at the International Conference on Infant Studies, Providence, R.I., March, 1978.

Thoman, E.B., Acebo, C., Dreyer, C.A., Becker, P.T., & Freese, M.P. Individuality in the interactive process. In E.B. Thoman (Ed.), Origins of the infant's social responsiveness. Hillsdale, N.J.: Larry Erlbaum, in press.

Thoman, E.B., Becker, P.T., & Freese, M.P. Individual patterns of mother-infant interaction. In G.P. Sackett (Ed.), Observing behavior (Vol. 1). Baltimore: University Park, 1977.

Thoman, E.B., Leiderman, P.H., & Olson, J.P. Neonate-mother interaction during breast feeding. Developmental Psychology, 1972, 6, 110-118.

Tiedemann, D. Observations on the development of the mental faculties of children. In J.K. Gardner & H. Gardner (Eds.), First notes by observant parents. New York: Arno, 1975. (Originally published, 1787.)

Tinbergen, N. On aims and methods of ethology. In P.H. Klopfer & J.P. Hailman (Eds.), Control and development of behavior: An historical sample from the pens of ethologists. Reading, Mass.: Addison-Wesley, 1972.

Trause, M.A. Defining the limits of the sensitive period. Paper presented at the biennial meeting of the Society for Research in Child Development, New Orleans, March, 1977.

Tulkin, S.R. Social class differences in maternal and infant behavior. In P.H. Leiderman, S.R. Tulkin, & A. Rosenfeld (Eds.), Culture in infancy: Variations in the human experience. New York: Academic, 1977.

Tulkin, S.R., & Cohler, B.J. Child-rearing attitudes and mother-child interaction in the first year of life. Merrill- Palmer Quarterly, 1973, 19, 95-106.

Wachs, T.D. Utilization of a Piagetian approach in the investigation of early experience effects: A research strategy and some illustrative data. Merrill-Palmer Quarterly 1976, 22, 11-30.

Wachs, T.D. Early sex differences in reactivity to naturally occurring physical stimulation. Paper presented at the International Conference on Infant Studies, Providence, R.I., March, 1978.

Wachs, T.D., Francis, T., & McQuiston,S. Psychological dimensions of the infant's physical environment. Paper presented to the Annual Meeting of the Midwestern Psychological Association, Chicago, May, 1978.

Wachs, T.D., Uzgiris, I., & Hunt, J.McV. Cognitive development in infants of different age levels and from different experimental backgrounds. Merrill-Palmer Quarterly, 1971, 17, 283-317.

Weatherstone, K.W. Comparisons between the nursery and rooming-in environments of the newborn. Unpublished manuscript, University of Kansas, 1976.

White, B.L. The first three years of life. Englewood Cliffs, N.J.: Prentice-Hall, 1975.

Willems, E.P. Behavioral ecology and experimental analysis: Courtship is not enough. In J.R. Nesselroade and H.W. Reese (Eds.), Life-span developmental psychology: Methodogical issues. New York: Academic, 1973.

Yarrow, L.J. Maternal deprivation: Toward an empirical and conceptual reevaluation. Psychological Bulletin, 1961, 58, 459-490.

Yarrow, L.J. Research in dimensions of early maternal care. Merrill-Palmer Quarterly, 1963, 9, 101-114.

Yarrow, L.J. Conceptualizing the early environment. In L.L. Dittman (Ed.), Early child care: The new perspectives. New York: Atherton, 1968.

Yarrow, L.J., Cain, R.L., Pedersen, F.A., & Rand, C.S.W. Manual for observation of home environment and mother-infant interaction. Unpublished manuscript, 1975.

Yarrow, L.J., Pedersen, F.A., & Rubenstein, J. Mother-infant interaction and development in infancy. In P.H. Leiderman, S.R. Tulkin, & A. Rosenfeld (Eds.), Culture and infancy: Variations in the human experience. New York: Academic, 1977.

Yarrow, L.J., Rubenstein, J.L., Pedersen, F.A. & Jankowski, J.J. Dimensions of early stimulation and their differential effects on infant development. Merrill-Palmer Quarterly, 1972, 18, 205-218.

Zajonc, R. Family configuration and intelligence. Science, 1976, 192, 227.